MILKEN INSTITUTE

NORTH AMERICA'S HIGH-TECH ECONOMY

The Geography of Knowledge-Based Industries

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Top-Ranked U.S. and Canadian Metros

* Top-performing Mexican states as of 2003, the last year for which data was available

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Table of Contents

Executive Summary

It has been nearly ten years since the Milken Institute first released *America's High-Tech Economy*. During that decade, we watched as the dot-com and technology bubble formed and subsequently popped in 2001. In the aftermath, many felt that the era of technology-based economic development had ceased—but these doubters have been proven wrong. A recovery in high-tech industries began in 2003 and fueled growth once again, a trend that continued through most of 2008.

Communities with concentrations of knowledge-based industries (such as information and communications technology, biopharmaceuticals, medical devices, and many others) have been able to create high-paying jobs, retain talented individuals, and attract firms from other locations, sparking additional growth. The current economic challenges we face will not leave high-tech sectors unscathed, but they will lead growth once again when we recover.

Top Performers

- Silicon Valley (the San Jose, California, metro area) remains the world's preeminent high-tech cluster. Its unique ecosystem of collaborating agents is unparalleled, resulting in a high-tech employment concentration that is four-and-a-half times the average for all North American metros.
- Seattle's 2nd-place ranking speaks to its crucial role in the knowledge geography of North America. It employs just 17,700 fewer high-tech workers than Silicon Valley, which had 244,000 in 2007.
- Third-ranked Cambridge places in the top ten in nine separate high-tech industries and has a concentration exceeding the North American average in seventeen industries—an achievement that exceeds even Silicon Valley.
- Washington, D.C., ranks 4th, placing in the top ten in six out of eight high-tech service categories, a better performance on this measure than any other metro area.
- Close behind Washington is 5th-ranked Los Angeles, home to many aerospace and high-end digital special effects jobs.
- Dallas is 6th, followed by San Diego (7th), Santa Ana/Orange County (8th), New York (9th), and San Francisco (10th).
- Toronto is Canada's highest-ranking tech center, ranking 15th overall with 157,400 high-tech workers in 2007. Montréal was Canada's second metro to make the top twenty, coming in at 19th. These two metros were the fastest-growing tech centers in the top twenty between 2003 and 2007.
- In order to quantify Mexico's performance, we compiled a separate set of rankings for 2003, the latest year for which Mexican data are available. In that analysis, the state of Baja California was Mexico's best performer at 15th place in North America, followed by the Distrito Federal (the Mexico City region) in 19th place.

In this study, we examine the locations and patterns of growth in nineteen individual high-tech industry categories. We then aggregate those results to determine overall high-tech performance. In each category, individual metro areas are then ranked according to their performance as "tech poles." This benchmarking metric is based on employment and wages; it also looks at the concentration of technology in the local economy and each metro's relative share of aggregate North American activity.

For this newly updated edition, we have extended the geography of our study to encompass all of North America, including our Canadian neighbors to the north and Mexican neighbors to the south. We can now answer questions such as, "Does Ottawa rank ahead of San Jose in communications equipment?" (Yes) and "Could Baja California lead North America in semiconductor and other electronic components manufacturing?" (Close, but not quite). We believe this to be the most detailed comparative assessment available for understanding North America's high-tech landscape.

Top-Performing U.S. and Canadian Metros

Silicon Valley (the **San Jose–Sunnyvale–Santa Clara, California,** metro area) remains the preeminent high-tech cluster in North America and the world, placing 1st on our tech pole index.

Silicon Valley's unique ecosystem of collaborating agents has an unmatched ability to spawn entrepreneurial firms that create new products, services, and even entire industries, while sustaining major high-tech anchor firms that remain at the leading edge of innovation in their industries. The region's unrivaled absorptive capacity[1] allows it to capture new internally generated knowledge, slowing the inevitable spillover to other regions, and convert it into economically viable entities better than any other location. Its firms see research and development as part of their very DNA; they continue to innovate as part of their core business mission rather than viewing innovation an expense to be minimized in a challenging economic environment, such as the one we are in today.

Stanford University provides cutting-edge research and transfers it, along with top-notch graduates, to the private sector to fuel regional growth. Its alumni are among the most prominent entrepreneurs in the region, founding many of the leading firms. The University of California, Berkeley, and other local institutions also provide high-end human capital. Equally important, the area attracts highly skilled technical talent from around the nation and world.

The San Jose metro area has established itself as the leading node on the international high-tech network, a role it managed to retain even through the restructuring that occurred in the aftermath of the dot-com and tech bubbles. As business costs have escalated in the region, firms have outsourced more functions to other locations while retaining the highest-valued and most creative elements.[2] Many manufacturing activities for more heavily commoditized products were relocated outside the region. This process was not accomplished without substantial pain, as thousands of jobs were lost.

1. Ross DeVol and Armen Bedroussian, *Mind-to-Market: A Global Analysis of University Biotechnology Transfer and Commercialization* (Milken Institute: 2006), p.55.

2. Richard Florida, *Who's Your City? How the Creative Economy Is Making Where to Live the Most Important Decision of Your Life* (Basic Books, 2008), p. 114.

The Sand Hill Road venture capitalists of Silicon Valley now travel abroad more often to places like India, China, and Israel to fund new enterprises and seek partnerships. Many foreign-born engineers, software developers, and innovators have left Silicon Valley and returned to their native countries seeking opportunities and leading a wave of technology entrepreneurship. This process is now termed "brain circulation" rather than unidirectional "brain drain."[3] The inclination of these innovators is to partner with former colleagues in Silicon Valley.

Total high-tech results*

Top fifty ranked by 2007 tech pole scores

Current rank	2003 rank	Metro area	Employment (thousands)	LQ	Share of North American wages	Tech pole scores
1	1	San Jose-Sunnyvale-Santa Clara, CA	244.0	4.6	5.7%	100.0
2	3	Seattle-Bellevue-Everett, WA	226.3	2.7	3.2%	46.4
3	2	Cambridge-Newton-Framingham, MA	163.6	3.4	2.8%	45.2
4	5	Washington-Arlington-Alexandria, DC-VA-MD-WV	275.7	2.0	4.2%	41.8
5	4	Los Angeles-Long Beach-Glendale, CA	376.4	1.6	4.2%	40.2
6	6	Dallas-Plano-Irving, TX	187.7	1.5	2.4%	21.8
7	7	San Diego-Carlsbad-San Marcos, CA	136.4	1.8	2.0%	19.3
8	11	Santa Ana-Anaheim-Irvine, CA	147.0	1.7	1.6%	17.7
9	9	New York-White Plains-Wayne, NY-NJ	262.0	0.9	3.9%	16.8
10	8	San Francisco-San Mateo-Redwood City, CA	106.4	1.8	2.0%	16.1
11	13	Philadelphia, PA	145.4	1.3	1.9%	14.4
12	12	Atlanta-Sandy Springs-Marietta, GA	164.1	1.1	1.9%	14.0
13	10	Edison, NJ	103.5	1.7	1.5%	13.9
14	14	Chicago-Naperville-Joliet, IL	200.0	0.9	2.5%	13.3
15	25	Toronto, ON	157.4	1.1	1.3%	12.5
16	15	Oakland-Fremont-Hayward, CA	98.0	1.6	1.4%	12.1
17	18	Minneapolis-St. Paul-Bloomington, MN-WI	131.0	1.2	1.5%	11.9
18	17	Denver-Aurora, CO	107.5	1.5	1.3%	11.9
19	27	Montreal, QC	128.2	1.3	1.0%	11.8
20	16	Austin-Round Rock, TX	81.5	1.8	1.1%	11.6
21	21	Houston-Sugar Land-Baytown, TX	151.7	1.0	1.9%	11.6
22	29	Huntsville, AL	42.5	3.5	0.4%	10.5
23	20	Phoenix-Mesa-Scottsdale, AZ	124.9	1.1	1.4%	10.4
24	31	Wichita, KS	50.6	2.9	0.5%	10.3
25	23	Bethesda-Gaithersburg-Frederick, MD	67.8	2.0	0.9%	10.2
26	24	Durham, NC	44.4	2.6	0.7%	9.7
27	28	Portland-Vancouver-Beaverton, OR-WA	88.1	1.5	1.0%	9.6
28	19	Boulder, CO	34.0	3.5	0.5%	9.3
29	26	Newark-Union, NJ-PA	84.9	1.4	1.3%	9.3
30	22	Warren-Farmington Hills-Troy, MI	90.6	1.3	1.1%	9.0
31	30	Kansas City, MO-KS	82.2	1.4	0.9%	8.4
32	32	Baltimore-Towson, MD	92.9	1.2	1.1%	8.3
33	35	St. Louis, MO-IL	85.1	1.1	0.9%	6.7
34	44	Salt Lake City, UT	54.8	1.5	0.5%	5.6
35	36	Tampa-St. Petersburg-Clearwater, FL	76.9	1.0	0.7%	5.6
36	64	Vancouver, BC	69.5	1.1	0.5%	5.6
37	66	Ottawa, ON	42.8	1.8	0.4%	5.4
38	34	Raleigh-Cary, NC	45.7	1.5	0.6%	5.3
39	39	Albuquerque, NM	39.3	1.7	0.5%	5.2
40	33	Nassau-Suffolk, NY	71.8	1.0	0.8%	5.1
41	40	Indianapolis, IN	58.9	1.1	0.7%	4.9
42	38	Fort Worth-Arlington, TX	57.5	1.1	0.6%	4.8
43	46	Orlando-Kissimmee, FL	63.6	1.0	0.7%	4.7
44	47	Hartford-West Hartford-East Hartford, CT	48.4	1.3	0.6%	4.7
45	50	Columbus, OH	57.0	1.0	0.6%	4.4
46	45	Pittsburgh, PA	63.3	0.9	0.6%	4.3
47	41	Bridgeport-Stamford-Norwalk, CT	39.0	1.5	0.5%	4.3
48	49	Palm Bay-Melbourne-Titusville, FL	26.3	2.1	0.3%	4.1
49	42	Lake County-Kenosha County, IL-WI	35.0	1.5	0.5%	4.1
50	37	Colorado Springs, CO	27.9	1.8	0.4%	4.0

Sources: BLS, Moody's Economy.com, Statistics Canada.

*Note: Due to a lack of recent data, Mexico was excluded from these rankings. An analysis of Mexico's state-level performance, based on 2003 data, is found later in this report.

3. AnnaLee Saxenian, *The New Argonauts: Regional Advantage in a Global Economy* (Harvard University Press, 2006), p. 83.

The breadth of high-tech activity in the San Jose metro area is shown by its ranking of 1st or 2nd in seven (out of a possible nineteen) individual tech pole indexes for various industries. It places among the top ten in twelve individual categories, and has an employment concentration above the North American average (excluding Mexico)[4] in an impressive sixteen fields. Overall, its high-tech employment concentration is four-and-one-half times the metro average for North America. With a top tech pole index score of 100, it was more than twice as dominant in the North American context as the 2nd-place metro area, **Seattle-Bellevue-Everett, Washington,** which recorded a score of 46.4. San Jose may not overshadow the technology landscape as fully as it did ten years ago, but its position is remarkable.[5]

San Jose was 1st in the tech pole rankings in computer and peripheral equipment manufacturing, accounting for 17.0 percent of employment and 28.4 percent of wages for that industry in North America. Hewlett-Packard, Sun Microsystems, and Apple are the anchor companies in this field. The metro holds a similarly dominant position in semiconductor and other electronic component manufacturing, as Intel, Advanced Micro Devices, LSI Corp., and many other leading firms are based here. Home to the prominent search engines Google and Yahoo!, it's also the leader in data processing, hosting, and related services. Although Ottawa, Ontario, shot above San Jose to claim the top spot in communications equipment manufacturing, Silicon Valley remains an important center of influence, with Cisco and other firms.

Seattle's 2nd-place position on the tech pole index speaks to its important role in the knowledge geography of North America. For example, the Seattle metro area employed 226,300 high tech workers in 2007, just 17,700 fewer than San Jose. Seattle owes most of its stellar ranking to software and aerospace.

Microsoft, along with its spin-offs and other start-up firms, has positioned the Seattle metro area as the global center of software. Microsoft employs more than 33,000 workers in the metro area[6] and drives Seattle to a 1st-place ranking on the tech pole index for software publishers. An example of Seattle's dominance in software is that its tech pole score of 100 in this field is followed by a 2nd-place score of only 21.4, posted by the next leading city, Cambridge. Perhaps the most compelling example of its prowess in software can be found in the observation that Seattle captures 23.4 percent of wages in this field in all of North America.

Although it is no longer the corporate headquarters of Boeing, Seattle retains a huge employment base of the firm's operations and related suppliers. Altogether, Seattle employed 76,100 workers in aerospace products and parts manufacturing in 2007. Only Wichita, Kansas, has a higher concentration of aerospace activity. Seattle also ranks among the top ten tech poles in telecommunications and other information services.

Part of the Greater Boston metro area, the metro division of **Cambridge-Newton-Framingham, Massachusetts,** is 3rd on the overall tech pole index at 45.2, edged out of 2nd place by just 1.2 index points. Home to world-class research universities such as Harvard and MIT, and the global leader in commercializing and transferring its research to the private sector, the metro area has a track record of technology entrepreneurship that rivals

4. Comparable 2007 metro data was not available for Mexico, so the tech pole rankings for metros areas examines only the United States and Canada. A separate section of this report incorporates 2003 state-level high-tech data for Mexico.

5. Ross DeVol and Perry Wong, *America's High-Tech Economy: Growth, Development and Risks for Metropolitan Areas* (Milken Institute, 1999), p. 6.

6. Moody's Economy.com, Précis Metro Seattle.

San Jose's. This local talent pool comes from locations all over the planet. The research intensity in the area has enabled Cambridge to be among the elite locations for generating and growing biotech start-ups, while simultaneously attracting research divisions of large pharmaceutical and biotech firms. It's the birthplace of much of the mainframe computer industry and remains a major player today.

Cambridge is the top-ranked tech pole in scientific research and development services, a category that captures much of its biotech research; this field employed 26,000 local workers in 2007. These activities are nearly eight times more concentrated in the Cambridge area than in North America overall. Biogen Idec and Genzyme are its two most prominent self-incubated biotech firms, while the Novartis Institutes for Biomedical Research and Millennium Pharmaceuticals are examples of other major players.[7] The presence of Boston Scientific helps place the metro area among the leaders in navigational, measuring, electromedical, and control instruments manufacturing. Cambridge ranks 2nd on the software tech pole index, makes the top ten in nine individual industries, and has a concentration above the national average in seventeen categories—exceeding even San Jose for top honors in that measure.

Washington-Arlington-Alexandria, DC-VA-MD-WV, is 4th among tech poles with an index score of 41.8, just ahead o f Los Angeles. The area is the North American leader among high-tech services. Overall, firms in the Washington metro area employed 275,700 high-tech workers, creating double the North American concentration in 2007. Washington places in the top ten in six out of eight high-tech service categories. The presence of the federal government generates the need for massive data-processing support and attracts defense and aerospace contractors.[8] Additionally, Washington's workforce is one of the most educated in the United States.[9]

Washington leads in computer systems design and related services, where it has more than five times the concentration found in North America overall; this field employed 127,000 workers in 2007. In this sector, it is twice as dominant as 2nd-place San Jose on the tech pole index. As a telecommunications hub and a large Internet presence, it has gained an important competitive advantage by creating economies of scale due to high local demand. Computer systems design is now the largest non-government sector in the metro area; the Computer Science Corporation itself employs more than 11,000.[10] IBM has a major footprint as well. Washington is 3rd in scientific research and development services, where biotech and other research in the hard sciences are captured. The National Institutes of Health (NIH) and its spin-offs in the biotech area aid the metro area's performance.

Los Angeles–Long Beach–Glendale, California, ranks 5th on the tech pole index at 40.2, courtesy of its still vast aerospace footprint and the technology-intensive segment of the motion picture industry. The area has a large research base, with leading institutions such as the California Institute of Technology (Cal Tech), UCLA, and USC. Combined, they provide the area with outstanding medical research expertise, especially in the biotech area.

7. Kelly Porter, et al, "The Institutional Embeddedness of High-Tech Regions: Relational Foundations of the Boston Biotechnology Community," in *Clusters, Networks, and Innovation*, Sefano Breschi and Franco Malerba, eds. (Oxford University Press, 2005), pp. 261–289.

8. Maryann P. Feldman, "The Entrepreneurial Event Revisited: Firm Formation in a Regional Context," in *Handbook of Research and Innovation and Clusters: Cases and Policies*, Charlie Karlsson, ed. (Edward Elgar Publishing, 2008), p. 337.

9. Richard Florida, *The Flight of the Creative Class: The New Global Competition for Talent* (HarperCollins Publishers, 2005), p. 174.

10. Moody's Economy.com, Précis Metro Washington.

Los Angeles is the top tech pole for navigational, measuring, electromedical and control instruments manufacturing. This sector employed 36,200 local workers in 2007. Los Angeles is the headquarters of Northrop Grumman, and Boeing retains major operations in the area. The metro area is 5th in aerospace and products and parts manufacturing, with 38,000 jobs. Clearly, the inclusion of motion picture and video in our definition of high-tech industries boosts L.A.'s position in the tech pole rankings, but this categorization is justified in order to capture high-end special effects and post-production talent. Los Angeles has 31.8 percent of North American employment in motion pictures.

The Dallas-Plano-Irving, Texas, metro division is 6th on the overall tech pole index. Its high-tech strengths lie in ICT hardware and data processing services. Overall, with 187,700 high-tech workers and a concentration 50 percent above the North American average in 2007, the metro area is an important player globally as well.

Dallas is 2nd in telecommunications, with major operations of Verizon and the new AT&T consolidating its corporate headquarters in the region. Placing 3rd in communications equipment manufacturing, the metro is renowned for its Dallas-Richardson telecom corridor. With Texas Instruments as its anchor, it places 6th on the semiconductor and other electronic component manufacturing tech pole index. The University of Texas, Dallas, has an outstanding engineering program that provides homegrown talent to fuel growth in these sectors. Dallas moved to 2nd, up from 3rd in 2003, in data processing, hosting, and related services. A number of data processing centers are located here, with Electronic Data Systems being the primary anchor.

San Diego–Carlsbad–San Marcos, California, is an important high-tech center with the world's most geographically dense biotech cluster, an enviable position in telecom hardware and services, and strong representation in several fields. San Diego had 136,400 high-tech jobs and was more than 80 percent more dependent on technology than the average for North America in 2007. The metro area placed in the top ten in four of the individual high-tech sectors and had a concentration above the North American average in fourteen categories.

San Diego's biotech network is closely knit and includes a wide range of members. The research milieu includes The Scripps Research Institute, the Salk Institute for Biological Studies, the Burnham Institute, and the University of California, San Diego.[11] Its research institutes and firms receive a disproportionate share of NIH funding, National Science Foundation basic research funding, Small Business Innovation Research Awards, and Small Business Technology Transfer awards in biotech research. The metro is home to large biotech firms such as Amylin Pharmaceuticals and many mid-sized and start-up firms. Qualcomm is the key player in the communication chips area, and AT&T has a major presence in the telecommunications space.

Just north of San Diego, **Santa Ana–Anaheim-Irvine (Orange County, California)** is 8th on the tech pole index, a climb of three places from 2003. Medical equipment manufacturing; medical and diagnostic labs; and measuring, electromedical and control instruments manufacturing are key drivers of high-tech growth. Santa Ana ranks among the top ten in six individual categories and exceeds the North American concentration in sixteen—tying San Jose for 2nd place in this measure. Additionally, Broadcom is a key player in communication chips.

11. Ross DeVol, Perry Wong, Junghoon Ki, Armen Bedroussian, and Rob Koepp, *America's Biotech and Life Sciences Clusters: San Diego's Position and Economic Contributions* (Milken Institute, 2004), p.3.

Part of the Greater New York area, the metro division of **New York–White Plains–Wayne, New York–New Jersey,** places 9th on the overall tech pole list. It is aided by its large absolute size, of course, but with 262,000 high-tech workers, it's hard to ignore. As an important entertainment hub, New York is 2nd only to Los Angeles in motion pictures and video industries. It is a key location of Internet portals and places 3rd in other information services.

San Francisco–San Mateo–Redwood City, California, remains in the top ten in 2007, slipping two positions from its 8th-place finish in 2003. The bursting of the dot-com bubble hit San Francisco hard, but the creativity of its entrepreneurs and its highly skilled workforce allows the region to constantly reinvent itself. It is the "birthplace of biotech," and indeed, biotech heavyweight Genentech emerged out of locally based university research. It ranks 5th among software publishers, with major operations of Electronic Arts and Oracle. San Francisco is a major hub of data processing, hosting, and related services, where it ranks 7th, and of computer systems design and related services. Within high-tech services, it ranks just behind Washington, D.C.

The **Philadelphia, Pennsylvania,** division of the Greater Philadelphia metro area is 11th on the tech pole index, rising two slots from its 2003 position. The area serves as a base to a whole host of pharmaceutical companies, including Merck, Wyeth, and GlaxoSmithKline, as well as biotech firms such as Cephalon. Philadelphia ranks 8th in scientific research and development services, up from 14th in 2003, courtesy of rapid growth in biotech. Philadelphia is strong in medical devices as well.

Atlanta–Sandy Springs–Marietta, Georgia, is 12th on the tech pole index. It ranks 1st in telecommunications, edging out Dallas for the distinction. AT&T's Mobility division is the biggest player in telecommunications; in total, the sector employs 37,900 local workers in Atlanta. The metro area has seven individual high-tech sectors that are more concentrated than the North American average.

Edison, New Jersey, ranked 13th in 2007. It placed 3rd in pharmaceutical and medicine manufacturing, with 16,800 workers and major players such as Bristol-Myers Squibb and Johnson & Johnson. Edison is a top-ten performer in telecommunications as well.

The **Chicago, Illinois,** division of the Greater Chicago metro area finished 14th in 2007. It ranks among the top ten in telecommunications and computer systems design and related services. Altogether, some 200,000 local workers were employed in high-tech industries in 2007. Motorola in the telecom space and Abbott Labs in pharmaceuticals are its two biggest high-tech firms.

Toronto, Ontario, is Canada's highest-ranking tech center, coming in at 15th. With 157,400 local jobs, its high-tech sector is the 10th largest in all of North America in terms of absolute size. The region scores among the top ten in a number of high-tech industries we examined—namely, manufacturing and reproducing of optical media, biopharmaceuticals, and medical and diagnostic laboratories. The metro area has nurtured a thriving film cluster as well. Toronto has been a magnet for high-end technical and creative talent from around the world. Additionally, the Canadian data show that Toronto jumped ten places from 2003. It scores high on the biopharmaceutical tech pole index, with more than 11,000 employed in the sector. Major players in the region include GlaxoSmithKine and Apotex. Private-public research collaborations involving the University of Toronto

and McMaster University have propelled the metro's emergence as an attractive place for biopharmaceuticals.[12] Toronto is Canada's leading center of computer systems design and related services, a category in which it ranks 8th in North America.

Oakland-Fremont-Hayward, California, is 16th on the tech pole index for 2007. Although it doesn't record a top-ten finish in any of the nineteen high-tech categories, it achieved a strong ranking overall by having a concentration exceeding the North American average in sixteen of them. Centered in proximity to Berkeley, it has a number of biotech firms and its major tech employers include Oracle and Sybase.

Placing 17th on the tech pole index in 2007, **Minneapolis–St. Paul–Bloomington, Minnesota-Wisconsin,** owes its position to medical devices giants Medtronics and Boston Scientific. Overall, Minneapolis has a higher concentration than North America in nine high-tech categories.

Denver-Aurora, Colorado, comes in at 18th place on the tech pole index and is 4th in telecommunications. Anchor firm Qwest Communications is the largest employer in the metro area. It has a greater concentration in nine of the high-tech categories than the North American average.

Montréal, Québec, Canada's second metro to make the top twenty, comes in at 19th place, gaining eight spots since 2003. Montréal boasts more than 128,000 high-tech jobs, with aerospace as a primary strength. Bombardier, along with Pratt & Whitney, is a significant driver of the sector's growth. Bombardier is headquartered in the metro, accounting for many of the nearly 21,000 aerospace-related jobs here. Montréal's aerospace cluster is widely supported though its formidable research capacity, as evidenced by its 197 research centers and four major universities.[13]

Austin–Round Rock, Texas, a poster child for the concept of a 21st-century knowledge-based community, rounds out the top twenty. Among high-tech industries, its highest concentration is in computer and peripheral equipment manufacturing; it is ten-and-a-half times more dependent on this sector than North America overall. Dell is the major computer manufacturer, along with IBM; electronic component firms Applied Materials, Advanced Micro Devices, Flextronics, Samsung Austin Semiconductor, and others play a major role in the area's economy.

Mexican States

In order to create a complete set of rankings within the North American context that includes Mexico, we had to utilize information gathered at the state level to develop comparable high-tech industry data. Mexican data was only available through 2003, so we place Mexican states among U.S. and Canadian metros for comparative purposes. Using state-level data pushes up total employment and wages for Mexican locations, but it also reduces the overall concentration of jobs in each sector, as the entire state (not just the leading city) must be considered.

12. Toronto Region Research Alliance, *Annual Toronto Region Innovation Gauge*, 2007, p.24.

13. Montréal International, *Greater Montreal 2006, High Technology and Innovation Indicators*, p. 23.

Baja California, which occupies the northern half of the Baja California peninsula (and includes the cities of Tijuana, Mexicali, and Ensenada), is the top-ranking Mexican state in the 2003 tech pole index, which includes all three nations. Placing 15th, it recorded total high-employment of 104,000 in 2003. Foreign firms were attracted by the Maquiladora Decree of 1989, which granted them complete ownership of their facilities provided they leased the land if it was located near the borders or coast, and provided that the products manufactured were to be exported.[14] Because most products of these factories are intended for export to the United States or Canada, they are located in industrial zones close to the U.S. border, and Baja California is a clear beneficiary of this trend. The region was the top tech pole in audio and video equipment manufacturing.

Firms such as Casio, Honeywell, Sanyo, and Sony have electronic components factories in Baja California, boosting the area to 2nd place (after San Jose) on the tech pole ranking for the manufacturing of semiconductors and other electronic components. Baja's concentration of employment in this category actually exceeds San Jose, although it is largely made up of lower-value manufacturing.

Baja California led North America in medical equipment and supplies manufacturing, with 22,200 workers; it was more than sixteen times more dependent on this activity than the North American average in 2003. In 2003, Baja California's medical product cluster was home to sixty different companies, of which more than forty were divisions of U.S. firms. Of those, thirteen were actually subsidiaries of San Diego–based companies or corporate divisions.[15] Communications equipment was another area where Baja California was in the top ten. Overall, Baja California has more than three times the concentration of high-tech employment as in North America overall.

The **Distrito Federal,** which encompasses Mexico City and its immediate surrounding area, is the second-ranking Mexican state, placing 19th overall in North America in our 2003 tech pole index. The Distrito Federal was the top telecommunications performer in North America in 2003. The industry is highly concentrated in Mexico City due to the monopoly of Telefónicas de México (Telmex). The concentration of telecommunications in the region is nearly three-and-one-half times greater than all of North America and its employment level (82,100) was nearly double the 2nd-ranking area (Atlanta).

The Distrito Federal ranks 6th in pharmaceutical and medicine manufacturing in North America, with 33,700 local workers (more than any U.S. or Canadian metro). In addition to the presence of Mexican pharmaceutical manufacturers, the state is also home to several foreign firms. Abbott Labs of the United States and the German firm Bayer each employ more than 2,500 workers in the state.[16] Filmmaking is also highly concentrated around Mexico City, resulting in its 4th-place ranking in North America. The ability to export Mexican film and television products to other parts of Latin America as well as a large home market has given the industry cluster around Mexico City a comparative advantage. Employment in this field is actually the third-largest of any of the locations on the list.

14. http://www.mexconnect.com/business/mex2000maquiladora2.html

15. http://www.crossborderbusiness.com/publicdocs/2006-CGMktgMaterials/0408-BioMedBriefing-final2.pdf

16. Dun and Bradstreet WorldBase, Lexis/Nexis Total Research System, accessed March 2009.

Introduction

Technology's central role in propelling economic growth in the United States and Canada began to come into focus in the mid-1990s. The initial discourse was confined to the ways that technology was being deployed in boosting economy-wide productivity growth. It wasn't long before economists pointed out that high-tech industries were accounting for a disproportionate share of overall GDP growth. Eventually we proposed that high-tech sectors were actually *determining* which regions and metropolitan areas experienced rapid growth in high-wage jobs and value-added economic activity.

In our 1999 release of *America's High Tech Economy*, the Milken Institute documented that high tech was the biggest single factor in explaining why some communities recorded exceptional growth. We also highlighted where the leading agglomerations or clusters were located.

Some of this growth was borrowed from the future, based upon the expectation that Y2K might cause severe economic and business disruptions without massive investment in information technology. When this spending was removed in 2000, it contributed to a major downward correction. Furthermore, much of the growth in second half of the 1990s was concentrated in dot-com businesses that had no foreseeable pathway to profitability, despite venture capitalist throwing fistfuls of money at them.

When the dot-com and Y2K-related bubble burst in 2001, many pundits believed that technology-based economic growth was history—a fad whose moment had passed. But a recovery in high-tech industries began in 2003 and fueled growth once again through most of 2008.

In this study, we examine the locations and patterns of growth in nineteen individual high-tech categories and in total high-tech performance after 2003. We extend the geography to include all of North America, including our Canadian neighbors to the north and Mexican neighbors to the south, identifying those areas that are major "tech poles," or vibrant clusters of high-tech activity. We believe this to be the most detailed benchmarking available of the technology landscape of North America.

We have adjusted our criteria from the approach deployed in our 1999 study. We originally based the tech pole ranking on an output concept (gross product originating) that overstated the economic impact of several high-tech manufacturing categories, such as semiconductors and other electronic components, in several communities. For example, the value of chip production might be very high as reflected in sales revenue, but that value cannot be fully retained in the community. Albuquerque was an extreme case, placing 7th in the 1999 tech-pole index, but slipping to 39th in our updated 2007 index. Consequently, we have revised our criteria to utilize employment and wages, which provide a better assessment of the true impact on the communities where high-tech activity is located.

We rely on two primary concepts to develop the tech pole score. The first examines the concentration of high-tech industry in the metropolitan area (or state, in the case of Mexico) relative to the North American average. We use *location quotients* to measure this. A location quotient (LQ) is calculated by determining the share of employment or wages in a metro, then dividing by the same ratio for North America for each high-tech industry. For example, if the LQ in a metro for a particular industry is 1.0, it matches the North American

average concentration. On the other hand, an LQ of 1.5 shows that the high-tech industry is 50 percent more concentrated in the metro than in North America overall. An LQ of 2.0 conveys that the local concentration of high-tech industries is twice that of North America.

The LQ approach is a necessary but insufficient measure in determining the relative importance of a metro in a particular high-tech category. Some smaller metros have a very high concentration in a given industry, but don't have much of a role to play in the larger North American context. We adjust for this by calculating what share each metro represents of the North American total by high-tech category. We multiply the LQ by the share of the North American total for both employment and wages. Next, each metro is rebased to the top-scoring metro, which receives a score of 100. This gives us a powerful spatial measurement of high-tech industries in North America. (See the Methodology section at the end of this report for a more detailed description of the underlying data and estimation techniques.)

In the following section, we analyze and rank U.S. and Canadian metros using 2007 data, the most recent available. Comparable Mexican data was only available at the state level and through 2003, so the subsequent section of this report evaluates the performance of Mexican states relative to U.S. and Canadian metros for 2003.

High-Tech Industry Rankings of U.S. and Canadian Metro Areas

A detailed explanation of each industry discussed in this report, as defined by the North American Classification System, is available at http://www.census.gov/naics.

Pharmaceutical and Medicine Manufacturing: NAICS 3524

This category (often referred to as biopharmaceuticals) encompasses both biotechnology and pharmaceuticals manufacturing. It includes the manufacturing of biological and medicinal products and the processing of botanical drugs and herbs. This industry is among the leaders in R&D investment, consistently reinvesting between 15 to 20 percent relative to sales.[17]

Pharmaceutical and medicinal manufacturing: NAICS 3254
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	1	Lake County-Kenosha County, IL-WI	14.9	17.4	4.6%	$1,859	6.3%	100.0
2	2	Newark-Union, NJ-PA	21.7	9.8	6.7%	$3,156	10.7%	86.4
3	5	Edison, NJ	16.8	7.5	5.2%	$1,646	5.6%	44.7
4	4	Indianapolis, IN	12.7	6.5	3.9%	$1,580	5.3%	33.5
5	7	Oxnard-Thousand Oaks-Ventura, CA	7.2	11.3	2.2%	$1,010	3.4%	33.2
6	3	Durham, NC	6.9	11.3	2.1%	$999	3.4%	32.9
7	6	Philadelphia, PA	16.9	4.1	5.2%	$1,766	6.0%	25.1
8	8	San Francisco-San Mateo-Redwood City, CA	8.1	3.8	2.5%	$1,821	6.2%	15.5
9	14	Toronto, ON	11.1	2.2	3.4%	$495	1.7%	7.8
10	11	Norwich-New London, CT	2.5	8.7	0.8%	$186	0.6%	7.4

Sources: BLS, Moody's Economy.com, Statistics Canada.

Part of Greater Chicago, the **Lake County–Kenosha County** metro area ranked 1st in North America on this category's 2007 tech pole index.[18] Nearly 15,000 workers are employed in biopharmaceuticals, which is the largest local employment source after government. Its employment concentration is 17 times higher in Lake County–Kenosha County than in North America on average (excluding Mexico).[19] Abbott Laboratories, which is headquartered here, serves as a major contributor to the region's overall wealth.[20]

Similarly, the vast presence of Merck, Schering-Plough, Novartis, and Pfizer in **Newark, New Jersey,** contributes to its 2nd-place ranking on the tech pole index.[21] Almost 22,000 workers are employed in biopharmaceuticals in this metro region. They represent roughly 6.7 percent of the overall industry's employment base in all of North America. With major players such as Bristol-Myers Squibb and Johnson & Johnson, **Edison, New Jersey,** takes the 3rd spot on the list. Similarly, the enormous operations of Eli Lilly in **Indianapolis** and of Amgen in **Oxnard–Thousand Oaks–Ventura** (part of Greater Los Angeles) contributed to these two metros landing top rankings of 4th and 5th,

17. Ross DeVol, Perry Wong, Armen Bedroussian, Lorna Wallace, Junghoon Ki, Daneila Murphy, and Rob Koepp, *Biopharmaceutical Industry Contributions to State and U.S. Economies* (Milken Institute, 2004), p. 14.

18. See the "Methodology" section at the end of this report for a complete description of how the tech pole index was developed.

19. Mexico was excluded from North American metro totals since comparable data was available only at the state level. All references to the North American metro totals mentioned throughout this section exclude Mexico. Mexico's 2003 state-level data is analyzed later in this report.

20. Ross DeVol, Rob Koepp, Kevin Klowden, and Armen Bedroussian, *The Illinois Pharmaceutical Industry: Survey of Economic Impact and Importance* (Milken Institute, 2004), p. 5.

21. Moody's Economy.com, Précis Metro Newark.

respectively. Additionally, biopharmaceutical job growth since 2003 in the Oxnard–Thousand Oaks–Ventura area was the third fastest relative to the North American average, just behind the rate posted by Lake County–Kenosha County.

Part of North Carolina's Research Triangle, **Durham** ranked 6th on the tech pole index, largely due to the presence of GlaxoSmithKline. The metro experienced the fourth-fastest employment growth in the sector since 2003 when benchmarked against all of North America. **Philadelphia** comes in 7th in this category, leveraging its strength as one the largest life science clusters in the nation. The area is home to operations for a host of pharmaceutical companies, including Merck, Wyeth, and GlaxoSmithKline, as well as biotech firms such as Cephalon. Next on the list is the "birthplace of biotech": the **San Francisco–San Mateo–Redwood City** metropolitan area. The heart of the Bay Area, it is situated amid a vast array of high-tech activity and is home to Genentech and many biotech start-ups and medium-sized firms.

The highest-ranking Canadian metro, **Toronto** placed 9th overall on the biopharmaceutical tech pole index, employing just over 11,000 workers in this sector. Major players in the region include GlaxoSmithKine and Apotex. Private-public research collaborations involving the University of Toronto and McMaster University have propelled the metro's emergence as an attractive place for biopharmaceuticals.[22]

Montréal, which ranked 18th in this category, has more than 6,000 residents employed in this sector, mostly with firms such as ClinTrials BioResearch, MerckFrosst Canada, and Wyeth Canada.

Comparing these updated rankings with the top ten metros from 2003, changes among the top U.S. finishers were minimal; in fact, the mix of metros in the top eight remained unchanged.

The current economic downturn is likely to spur consolidation and buyouts in this industry. During this process, individual regions may witness a restructuring in their biopharmaceutical employment base, with some areas experiencing declines. Additionally, now that health-care reform is a top priority for the U.S. government, new policies could emerge that present both challenges and opportunities for firms engaged in the industry.

Commercial and Service Industry Machinery Manufacturing: NAICS 3333

This high-tech industry involves the manufacturing of automatic vending, laundry, and optical machines. It also encompasses establishments that manufacture photographic and other office-related equipment (excluding computers).

The top-ranked metro was **Rochester, New York,** with an employment base of 7,400. In fact, Rochester dominates this category like few other metros do in any other high-tech industry, claiming 6.4 and 8.7 percent of the employment and wage share, respectively, of the overall sector in North America. The city is home to Eastman Kodak and to manufacturing operations for the Xerox Corporation. Since 2003, this industry's growth has skyrocketed, with employment and wage growth among the fastest in all of North America.

22. Toronto Region Research Alliance, *Annual Toronto Region Innovation Gauge*, 2007, p. 24.

Commercial and service industry machinery manufacturing: NAICS 3333
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	1	Rochester, NY	7.4	18.9	6.4%	$600	8.7%	100.0
2	3	Bridgeport-Stamford-Norwalk, CT	3.4	10.1	2.9%	$343	5.0%	23.1
3	13	Rockingham County-Strafford County, NH	1.4	9.6	1.2%	$110	1.6%	9.3
4	6	La Crosse, WI-MN	0.7	11.7	0.6%	$69	1.0%	7.1
5	66	Palm Bay-Melbourne-Titusville, FL	1.4	8.4	1.2%	$15	0.2%	6.0
6	9	Chicago-Naperville-Joliet, IL	5.0	1.7	4.3%	$388	5.7%	5.5
7	5	Orlando-Kissimmee, FL	2.2	2.6	1.9%	$252	3.7%	5.3
8	2	San Jose-Sunnyvale-Santa Clara, CA	1.7	2.4	1.5%	$363	5.3%	4.9
9	16	Fort Collins-Loveland, CO	0.9	8.8	0.8%	$46	0.7%	4.8
10	7	Minneapolis-St. Paul-Bloomington, MN-WI	3.2	2.3	2.8%	$205	3.0%	4.6

Sources: BLS, Moody's Economy.com, Statistics Canada.

With 3,400 jobs in the industry, the metro of **Bridgeport-Stamford-Norwalk, Connecticut,** home to General Electric, ranked 2nd.

Posting the fastest job growth among the ten on the tech pole index were the metros of **Rockingham County–Strafford County, New Hampshire** (ranked 3rd) and **Palm Bay–Melbourne-Titusville, Florida** (ranked 5th). The industry's largest employers in Rockingham County include General Electric's Motor Business, Goss International Americas, and Fisher Scientific International,[23] all which lend support to high-tech manufacturing in the region. Palm Bay has diversified its mix of high-tech activity over the last few years, dramatically improving its ranking from the 2003 tech pole index. In addition to a large presence of aerospace and defense, Palm Bay has expanded its high-tech base and is developing various optical instruments.

In 7th-ranked **Orlando,** the industry employs 2,200 workers, many in the optical instrument and lens manufacturing sub-sector. The University of Central Florida's highly regarded program in optics and photonics lends supports to companies specializing in this area.[24] **San Jose–Sunnyvale–Santa Clara's** 8th-place ranking provides yet another example of the advantages of developing a high-tech cluster. Once in place, it lures additional firms that want to locate in a region surrounded by agglomerations of closely tied networks and businesses.

The **Minneapolis–St. Paul–Bloomington** area's 10th-place ranking on the tech pole index is due to its enormous concentration in the field of medical devices. Strong correlation between the manufacturing of medical devices and commercial and machinery industry manufacturing yields a competitive advantage relative the metro's overall high-tech base.

Among Canadian metros, **Montréal** and **Toronto** rank 21st and 25th, respectively, on this industry's tech pole index. Manufacturing of high-end machinery lends direct support to many of the services provided by high-tech firms. Additionally, large-scale manufacturing of such equipment conducted locally suggests that these regions are capturing a fuller share of the production value chain.

23. "Largest Manufacturing Employers," *2009 Book of Lists* (New Hampshire Business Review, 2009).

24. Perry Wong and Armen Bedroussian, *Economic Benefits of Proposed University of Central Florida College of Medicine* (Milken Institute, 2004), p. 15.

Computer and Peripheral Equipment Manufacturing: NAICS 3341

Companies in this industry are engaged in the manufacturing and assembly of electronic computers, including mainframes, personal computers, and servers, as well as peripheral hardware such as storage devices, printers, and monitors. This category includes both analog and digital products.

The top five metros account for 36.2 percent of this industry's total employment in North America, a concentration level that ranks third behind motion picture and video industries, and aerospace and products and parts manufacturing, among all nineteen high-tech categories.

Computer and peripheral equipment manufacturing: NAICS 3341
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	1	San Jose-Sunnyvale-Santa Clara, CA	33.0	28.4	17.0%	$6,741	28.4%	100.0
2	2	Durham, NC	11.9	32.5	6.1%	$1,590	6.7%	38.7
3	3	Rochester, MN	5.0	36.5	2.6%	$550	2.3%	17.6
4	4	Austin-Round Rock, TX	10.2	10.5	5.2%	$1,301	5.5%	10.6
5	5	Cambridge-Newton-Framingham, MA	10.3	9.8	5.3%	$1,455	6.1%	9.8
6	7	Binghamton, NY	2.9	19.7	1.5%	$250	1.1%	5.3
7	13	Huntsville, AL	3.9	14.7	2.0%	$97	0.4%	4.9
8	9	Poughkeepsie-Newburgh-Middletown, NY	3.9	12.0	2.0%	$292	1.2%	4.2
9	14	Eau Claire, WI	2.2	20.9	1.1%	$105	0.4%	4.1
10	10	Lexington-Fayette, KY	3.8	11.6	1.9%	$265	1.1%	3.9

Sources: BLS, Moody's Economy.com, Statistics Canada.

San Jose–Sunnyvale–Santa Clara claimed the top spot in the tech pole rankings for this industry. Not surprising given its role as the heart of Silicon Valley, San Jose has more computer and peripheral equipment manufacturing activities than any other metro in North America (capturing 17.0 percent of all employment and 28.4 percent of all wages). With anchor companies like Hewlett-Packard, Sun Microsystems, and Apple, the metro area has been able to maintain its leadership in most high-tech industries since the turn of the millennium. Durham, North Carolina, came in a distant 2nd place in these rankings, as its rebased tech pole score was less than 40 percent of San Jose's. The rankings of top metropolitan regions in this industry tend to be stable; many cities have maintained their rankings from 2003.

Incidentally, although San Jose has the highest absolute number of employees in this industry in 2007, its location quotient was lower than that of Durham and 3rd-ranked Rochester, Minnesota. This means that the latter two regions have a higher *concentration* of computer and peripheral manufacturing industry activities.

Durham is one of three key cities in North Carolina's Research Triangle. Not only is it home to Duke University, but it is just a short drive from the University of North Carolina at Chapel Hill and North Carolina State University. Drawing from talents in these universities, Durham has a highly educated workforce and a strong high-tech presence. In the long run, the region can benefit from these assets, and has already developed highly sophisticated research and industry linkages in the Research Triangle, a prominent high-tech cluster.[25] The metropolitan region's employment in this industry grew almost twice as fast as the North American average between 2003 and 2007, rising from 9,132 to 11,944 employees. Durham's top two firms in this sector are IBM and the Lenovo Group.

25. Moody's Economy.com, Précis North Carolina.

The Mayo Clinic acts as a leading anchor in 3rd-place **Rochester, Minnesota,** indirectly sparking a chain of development in relevant high-tech companies.[26] One of the leading IT companies in the world, IBM employs more than 4,000 workers in the region. Although its well-educated workforce is a key asset, downsizing in local IT companies may make it challenging for Rochester to maintain its strong tech presence.[27]

Among Canadian metros, **Ottawa** comes in at 29th place. With more than 1,300 employees, its industry employment is nearly two-and-a-half times more concentrated than the North American average.

Communications Equipment Manufacturing: NAICS 3342

This category includes the manufacturing of telephone apparatus, radio and television broadcasting equipment, and various wireless communications equipment. The manufacturing of mobile phones, including smart phones, is also classified under this industry category.

Communications equipment manufacturing: NAICS 3342

Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	5	Ottawa, ON	7.6	18.1	5.0%	$464	3.7%	100.0
2	1	San Jose-Sunnyvale-Santa Clara, CA	8.3	9.1	5.4%	$929	7.5%	58.4
3	2	Dallas-Plano-Irving, TX	9.2	4.4	6.0%	$1,166	9.4%	36.0
4	3	Bethesda-Gaithersburg-Frederick, MD	4.4	7.6	2.9%	$412	3.3%	25.9
5	NA	Kitchener-Waterloo, ON	2.8	13.1	1.8%	$118	0.9%	25.8
6	6	Fort Wayne, IN	2.6	11.8	1.7%	$200	1.6%	23.8
7	15	Cedar Rapids, IA	2.2	15.7	1.4%	$34	0.3%	22.6
8	4	San Diego-Carlsbad-San Marcos, CA	4.2	3.2	2.8%	$787	6.3%	15.7
9	7	Rochester, NY	3.1	5.9	2.0%	$305	2.4%	15.3
10	16	Huntsville, AL	1.9	9.2	1.3%	$101	0.8%	12.5

Sources: BLS, Moody's Economy.com, Statistics Canada.

Ottawa has overtaken San Jose as the top tech pole in North America for communications equipment manufacturing in 2007. Supported by various communications manufacturers such as Nortel, JDS-Uniphase, and Mitel, Ottawa has become a distinguished leader in this category.[28]

Among U.S. metropolitan regions, **San Jose, Dallas,** and **Bethesda, Maryland,** ranked among the top five in 2003 and continued to do so in the most recent index. (San Jose was ranked 1st in 2003, while Dallas is renowned for the Dallas-Richardson telecom corridor.) Also of note is **Kitchener-Waterloo,** which shot to 5th place from a much lower position in 2003.[29] Finally, the huge presence of Qualcomm in **San Diego** has contributed to the region's top ten position in the category.

However, it is important to note that the communications equipment manufacturing industries in Ottawa and Kitchener-Waterloo do not employ as many people and do not disburse the same wages as their leading U.S. peers, San Jose and Dallas. Nevertheless, the rise of Ottawa and Kitchener-Waterloo between 2003 and 2007 highlights the innovation capabilities of their leading firms.

26. Ross DeVol and Perry Wong, *America's High-Tech Economy: Growth, Development and Risks for Metropolitan Areas* (Milken Institute, 1999), p5.

27. Moody's Economy.com, Metro Précis Rochester.

28. Leonel Corona, Jérôme Doutriax, and Sarfraz A. Mian, *Building Knowledge Regions in North America: Emerging Technology Innovation Poles* (Edward Elgar, 2006), p.101.

29. Because data was not available in 2003 for this industry in Kitchener-Waterloo, the metro could not be accurately ranked.

Though it posted employment of just 2,800 workers in this industry in 2007, Kitchener-Waterloo draws strength and potential from the clustering of high-tech companies in Canada's Technology Triangle (which includes the cities of Cambridge, Kitchener, and Waterloo). In 2007, *Foreign Direct Investment* magazine voted Canada's Technology Triangle as one of the top five "Small Cities of the Future" in North America. Boasting three quality universities (the University of Waterloo, Wilfrid Laurier University, and Conestoga College), the region is poised to leverage its strong human capital base for technological innovation.[30]

Of special note for this industry is the rising force of Research in Motion Ltd. as one of the world's leading provider of smart mobile solutions. The firm is largely responsible for the immense growth of Kitchener-Waterloo, where the company houses a large proportion of its operations. Research in Motion invented and produces the BlackBerry, a mobile phone with e-mail, text-messaging, web browsing, and other information capabilities. The global penetration of its service with both business and personal users puts the company on the world map of leading high-tech corporations.

Ottawa saw employment growth in this industry that was more than twice the magnitude of the North American average, jumping from roughly 4,500 to 7,600 workers between 2003 and 2007. The Communication Research Center, a government laboratory established in 1969, laid the foundation for communications firms to establish themselves in the area. In addition to its leading anchor firms, Ottawa has a thriving entrepreneurial ecosystem in communications equipment, with many start-up companies evolving into mature firms.

The presence of a major anchor company such as Research in Motion spurs a chain of positive developments, including the potential for growing full-fledged industry clusters. Establishments in these agglomerations are inter-related in their operations, facilitating positive networked effects that can be reaped by the larger region. In the cases of Kitchener and Ottawa, the regions are showing dramatic growth potential based on their tech pole scores. The base for innovation and cluster formation is a key asset for these regions.

Other leading centers include **Fort Wayne, Indiana; Cedar Rapids, Iowa; Rochester, New York;** and **Huntsville, Alabama.**

30. Canada's Technology Triangle Inc., "A High-Impact Location for High Tech and Research and Development Operations."

Audio and Video Equipment Manufacturing: NAICS 3343

Establishments in this industry are primarily involved in the manufacturing of electronic audio and video equipment, mainly used in home entertainment systems, vehicles, and instrument amplification.

Audio and video equipment manufacturing: NAICS 3343
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	1	San Diego-Carlsbad-San Marcos, CA	2.0	7.1	6.1%	$377	18.4%	100.0
2	3	Cambridge-Newton-Framingham, MA	1.9	10.6	5.7%	$91	4.5%	64.7
3	4	Scranton--Wilkes-Barre, PA	0.8	13.6	2.3%	$9	0.5%	32.3
4	5	Niles-Benton Harbor, MI	0.3	24.5	1.0%	$20	1.0%	29.9
5	7	Santa Ana-Anaheim-Irvine, CA	1.6	5.0	5.0%	$57	2.8%	26.1
6	18	Elkhart-Goshen, IN	0.5	17.1	1.5%	$8	0.4%	25.3
7	6	Bloomington, IN	0.4	20.7	1.1%	$5	0.2%	23.5
8	11	Cleveland, TN	0.3	27.2	0.8%	$1	0.0%	20.6
9	10	Jackson, TN	0.3	21.5	0.9%	$1	0.1%	19.0
10	8	Evansville, IN-KY	0.5	12.3	1.5%	$13	0.6%	18.6

Sources: BLS, Moody's Economy.com, Statistics Canada.

All of the top ten metropolitan regions in this industry showed employment growth of at least double the North American average for the period (2003 to 2007). In particular, **Elkhart, Indiana,** grew almost five times faster than the North American average (from 285 employees in 2003 to 481 employees in 2007).

Despite having a relatively small number of total employees based there, this industry has a high concentration of workers in Elkhart. The region jumped twelve places, from 18th in 2003 to 6th in 2007. However, it lacks industrial diversity and has an overly high dependence on manufacturing. Its lack of a highly educated workforce also puts the region at a disadvantage in terms of long-term growth in high tech.[31]

With a wage share of 18.4 percent, the **San Diego** metro area ranked 1st in the audio and video equipment manufacturing industry. Its strong R&D linkages with research institutions such as the University of California, San Diego, have propelled its high-tech sector toward an ever-larger role as a key contributor to the region's economic well-being.[32]

Given the current economic downturn, the corresponding decrease in investment spending and venture capital placements are likely to inhibit the development of new technology products. The audio and video equipment manufacturing industry appears particularly vulnerable to the effects of decreased consumer spending.

Semiconductor and Other Electronic Component Manufacturing: NAICS 3344

Capacitors, resistors, microprocessors, circuit boards, electron tubes, and modems are among the products manufactured by establishments in this industry. These are typically critical items in computer systems.

The most innovative region in the world by many measures, the **San Jose** metro area (Silicon Valley) is clearly the leader by a wide margin in the manufacturing of semiconductors and other electronic components. The metro area accounts for 10.3 percent of all employment (over 17 times more concentration than in North America overall) and a remarkable 21.5 percent of all wages disbursed by this industry in North America. San Jose is home to the headquarters of several leading companies in this field, with Intel, Advanced Micro Devices (AMD),

31. Moody's Economy.com, Précis Metro Elkhart.

32. Ross DeVol, et.al. *America's Biotech and Life Science Clusters: San Diego's Position and Economic Contributions* (Milken Institute, 2004).

LSI Corp., National Semiconductor, and Atmel Systems Corp. acting as regional anchor firms. These firms generate high levels of industry employment in the region. Indeed, San Jose has continued to show growth potential in this industry, with its employment base increasing 30 percent faster than the North American average from 2003 to 2007. Its entrepreneurs, universities, and Sand Hill Road venture capitalists collaborate to keep spinning out new firms in this industry at a remarkable pace.

Semiconductor and other electronic component manufacturing: NAICS 3344

Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	1	San Jose-Sunnyvale-Santa Clara, CA	47.8	17.3	10.3%	$7,600	21.5%	100.0
2	2	Portland-Vancouver-Beaverton, OR-WA	27.4	8.7	5.9%	$2,317	6.5%	24.6
3	5	Boise City-Nampa, ID	11.1	13.1	2.4%	$768	2.2%	14.5
4	3	Austin-Round Rock, TX	17.0	7.4	3.7%	$1,789	5.1%	14.0
5	4	Phoenix-Mesa-Scottsdale, AZ	24.9	4.3	5.4%	$2,169	6.1%	11.2
6	7	Dallas-Plano-Irving, TX	25.0	3.9	5.4%	$2,235	6.3%	10.2
7	8	Palm Bay-Melbourne-Titusville, FL	7.7	11.9	1.7%	$628	1.8%	9.4
8	6	Burlington-South Burlington, VT	5.3	14.9	1.1%	$429	1.2%	8.1
9	10	Cambridge-Newton-Framingham, MA	11.1	4.5	2.4%	$994	2.8%	5.0
10	15	Santa Ana-Anaheim-Irvine, CA	14.7	3.2	3.2%	$893	2.5%	4.4

Sources: BLS, Moody's Economy.com, Statistics Canada.

Portland, Oregon, ranked 2nd on this tech pole industry index, substantially behind San Jose. While its primary focus in Portland is centered on R&D, design, and production prototype, Intel is the biggest employer in the metro.[33] Similarly, Micron Technologies, a multinational producer of semiconductor devices, acts as the industry anchor in 3rd-place **Boise, Idaho.**

In addition to computer manufacturing, the semiconductor industry in 4th-place **Austin, Texas,** is an integral part of the metro's high-tech base. It is driven by a number of companies, including Freescale Semiconductor, AMD, Applied Materials, National Intruments, and Samsung Austin Semiconductor.[34]

Of note, **Phoenix** and **Dallas,** ranking 5th and 6th, respectively, also show strength in this industry, with each employing 5.4 percent of all workers in this industry in North America. In the case of Phoenix, Intel is a leading anchor in the region, employing more than 10,000 workers.[35] With its strong emphasis on value-added industries, Phoenix can improve the general skill levels of its workforce and position itself for long-term growth.

Texas Instruments Inc., headquartered in Dallas, serves as a leading anchor firm in the region, with more than 10,000 local employees.[36] Furthermore, in 2008, AT&T announced its relocation from San Antonio to Dallas.[37] Its presence can directly and indirectly facilitate regional growth in the overall high-tech sector.

Other significant players in this sector include **Palm Bay–Melbourne-Titusville, Florida; Burlington, Vermont;** and **Cambridge-Newton-Framingham, Massachusetts.** Finally, in **Santa Ana–Anaheim-Irvine, California,** the industry employs roughly 14,700 workers, adding yet another element to the metro area's high-tech cluster.

33. Moody's Economy.com, Précis Metro Portland.

34. *Austin Business Journal Book of Lists 2008* (American City Business Journals, 2008) and Greater Austin Chamber of Commerce, 2007.

35. Moody's Economy.com, Précis Metro Phoenix.

36. Moody's Economy.com, Précis Metro Dallas.

37. Victor Godinez, "AT&T Moving Headquarters to Dallas from San Antonio," *Dallas Morning Herald*, June 28, 2008.

Despite the 4,000 and 4,500 jobs created by the industry in **Montréal** (ranked 36th) and **Toronto** (ranked 42nd), respectively, this field is a relatively small part of their overall employment base.

This industry, like many others, is experiencing the negative effects of the economic downturn, with many metros hit by layoffs, even from leading firms. Even metros such as Phoenix and Dallas, which have considerable strengths, are feeling the effects in key industry anchors such as Intel and AT&T.[38] However, regions that have longstanding assets such as human capital may be poised to recover more quickly than others.

Navigational, Measuring, Electromedical, and Control Instruments Manufacturing: NAICS 3345

This industry involves the manufacturing of a wide range of specialized equipment, including magnetic resonance imaging (MRI) machines, aircraft instruments, electrical instruments, and irradiation apparatuses, among others.

Navigational, measuring, electromedical, and control instruments manufacturing: NAICS 3345
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	1	Los Angeles-Long Beach-Glendale, CA	36.2	2.8	7.7%	$4,733	12.5%	100.0
2	2	San Jose-Sunnyvale-Santa Clara, CA	18.3	6.5	3.9%	$1,728	4.6%	95.0
3	3	Cambridge-Newton-Framingham, MA	16.4	6.5	3.5%	$1,620	4.3%	88.1
4	5	Minneapolis-St. Paul-Bloomington, MN-WI	23.1	4.2	4.9%	$1,624	4.3%	75.3
5	6	Manchester-Nashua, NH	7.1	11.0	1.5%	$580	1.5%	63.8
6	4	Santa Ana-Anaheim-Irvine, CA	16.9	3.6	3.6%	$2,205	5.8%	59.4
7	9	Boulder, CO	4.5	8.7	1.0%	$346	0.9%	31.0
8	12	Binghamton, NY	3.3	9.3	0.7%	$255	0.7%	25.7
9	10	Phoenix-Mesa-Scottsdale, AZ	12.0	2.0	2.6%	$1,051	2.8%	20.8
10	11	Milwaukee-Waukesha-West Allis, WI	7.9	3.0	1.7%	$572	1.5%	19.0

Sources: BLS, Moody's Economy.com, Statistics Canada.

The tech pole scores among the top metropolitan regions in this industry are not as widely spaced as the preceding industries. Ranked 1st in both 2003 and 2007, the Greater **Los Angeles** area has a broad aerospace cluster, with Northrop Grumman and Boeing maintaining large presences. The data shows **San Jose** and **Cambridge** close behind in 2nd and 3rd place, respectively.

Ranking 4th in this industry index is **Minneapolis–St. Paul,** a key center of activity in this broad category. With 23,100 workers (the second-highest total in North America), the metro area specializes in medical devices, with Medtronic calling it home. Its dominance in the medical devices field only continues to grow.

Binghamton and Milwaukee, two metropolitan regions that were close but did not make the top ten in 2003, rose to 8th and 10th respectively.

Due to the region's vibrant defense industry, **Binghamton, New York,** can draw on a high concentration of high-tech workers. It can also offer those workers much more affordable housing relative to other major metropolitan regions in New York State. Lockheed Martin and IBM are major high-tech firms with operations in the region. However, the region is experiencing out-migration due to in part to its high business costs. Since the region's economy is dependent on the defense sector, decisions made by the incoming federal administration may have strong implications for its long-term growth.[39]

38. Moody's Economy.com, Précis Metro Phoenix, Précis Metro Dallas.

39. Moody's Economy.com, Précis Metro Binghamton.

Although **Milwaukee** did not grow as fast as all of North America with respect to employment in this industry, the metro area did move up one position to join the top ten in this industry index. Despite this positive performance, high tech is not the region's anchor industry. Education and health care are the most vital industries there, though these sectors have been shedding jobs in the economic downturn.[40]

Ottawa and **Toronto** rank 39th and 45th, respectively. While the industry employs 2,400 workers in Ottawa, it accounts for a relatively small share of total industry wages across North America. Toronto's 5,200 industry jobs comprise only a minor portion of the metro's employment base.

As with other computer-related manufacturing industries, this industry has been hit by the negative ripple effects of the overall economic slump. But in contrast to previous recessions, computer technologies have become a more firmly entrenched and integral part of government and business operations today.[41] Despite recent downsizing, computer-related manufacturing industries will continue to be an important component of the industry mix and the overall economy in the regions discussed above.

Manufacturing and Reproducing Magnetic and Optical Media: NAICS 3346

Establishments categorized under this industry code include those involved in the manufacturing of optical and magnetic recording media (such as blank audio tapes and compact discs) and software reproduction.

Manufacturing and reproducing magnetic and optical media: NAICS 3346
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	2	Huntsville, AL	2.4	40.6	5.6%	$162	5.4%	100.0
2	1	Oxnard-Thousand Oaks-Ventura, CA	1.2	14.0	2.7%	$357	11.8%	54.4
3	6	San Jose-Sunnyvale-Santa Clara, CA	2.9	11.1	6.7%	$247	8.2%	32.3
4	8	San Antonio, TX	2.2	9.4	5.1%	$0	0.0%	18.3
5	4	Anderson, IN	0.3	27.7	0.8%	$27	0.9%	10.4
6	7	Charlotte-Gastonia-Concord, NC-SC	1.2	4.8	2.7%	$208	6.9%	10.2
7	9	Provo-Orem, UT	0.7	13.0	1.6%	$51	1.7%	10.1
8	10	Detroit-Livonia-Dearborn, MI	1.5	6.6	3.4%	$97	3.2%	9.8
9	15	Toronto, ON	2.1	3.1	4.8%	$53	1.8%	5.9
10	13	Philadelphia, PA	1.2	2.2	2.8%	$179	5.9%	4.0

Sources: BLS, Moody's Economy.com, Statistics Canada.

Cinram International, the world's largest independent provider of pre-recorded multimedia products for the home entertainment industry, is headquartered in **Toronto** (which ranks 9th on this tech pole index) and has major operations in **Huntsville, Alabama** (ranked 1st). This sector has an employment location quotient above 40 in Huntsville, among the highest concentrations recorded in any high-tech sector among metropolitan areas. The company's presence alone has largely guaranteed the high rankings of these two metros in this category.

Second-ranked **Oxnard–Thousand Oaks–Ventura** captures nearly 12 percent of all wages disbursed in this industry throughout North America. The local presence of Technicolor Video Services is a major factor. The metro area benefits from its proximity to the much larger entertainment industry cluster in Greater Los Angeles.

40. Moody's Economy.com, Précis Metro Milwaukee.

41. Liz Warren, "Manufacturing Firms Cannot Afford to Slash IT Budgets," ComputerWeekly.com, November 17, 2008 (available at http://www.computerweekly.com/Articles/2008/11/17/233431/manufacturing-firms-cannot-afford-to-slash-it-budgets.htm).

The top-ranked metropolitan regions in this industry showed a fair amount of movement between 2003 and 2007. While Oxnard and **Anderson, Indiana,** maintained their top five rankings, **Toronto** and **Philadelphia** leapt into the top ten in the 2007 rankings, climbing from the 15th and 13th positions they held, respectively, in 2003.

Due to its nature, this sector supports the motion picture and video industry (NAICS 5121). Although much of the film industry remains concentrated in Los Angeles, some operations have moved to metropolitan regions in Canada, including Toronto, Montréal, and Vancouver. This accounts for strong growth in the manufacturing and reproducing magnetic and optical media industry in 9th-ranked Toronto.

Aerospace and Products and Parts Manufacturing: NAICS 3364

This industry consists of companies primarily engaged in the manufacturing of aircraft, guided missiles, and space vehicles, as well as the development of aircraft prototypes. It also includes the manufacturing of aerospace parts such as engines and propulsion units.

Aerospace products and parts manufacturing: NAICS 3364
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	1	Wichita, KS	38.7	36.7	7.3%	$2,709	6.6%	100.0
2	2	Seattle-Bellevue-Everett, WA	76.1	15.0	14.4%	$6,692	16.2%	87.0
3	3	Hartford-West Hartford-East Hartford, CT	20.5	9.4	3.9%	$1,970	4.8%	16.9
4	4	Fort Worth-Arlington, TX	22.3	7.4	4.2%	$1,823	4.4%	13.3
5	5	Los Angeles-Long Beach-Glendale, CA	38.0	2.6	7.2%	$2,809	6.8%	6.4
6	6	Tucson, AZ	11.8	8.8	2.2%	$525	1.3%	4.5
7	8	Phoenix-Mesa-Scottsdale, AZ	15.2	2.3	2.9%	$1,613	3.9%	4.2
8	7	Montreal, QC	20.8	3.6	3.9%	$1,333	3.2%	4.0
9	9	St. Louis, MO-IL	11.1	2.3	2.1%	$1,153	2.8%	3.0
10	11	Cincinnati-Middletown, OH-KY-IN	9.5	2.6	1.8%	$955	2.3%	2.8

Sources: BLS, Moody's Economy.com, Statistics Canada.

The employment location quotient (LQ) of 36.7 in top-ranked **Wichita, Kansas,** speaks volumes. Aerospace employment is the primary growth engine in the metro area, which is home to the headquarters of Cessna Aircraft and Sprit Aerosystems along with major operations for Boeing and Bombardier.[42] In total, almost 39,000 jobs in aerospace are based here.

Seattle's 2nd-place ranking is highly correlated with Boeing's dominant presence in the area. Combined, Wichita and Seattle represent over one-fifth of all jobs and wages disbursed in the industry within all of North America. Similarly, **Hartford's** ranking of 3rd place on the tech pole index for aerospace is largely driven by the presence of Pratt & Whitney headquarters.[43] It is yet another example of how a metro can benefit from attracting a key anchor firm and then leveraging the large investments that come along with it.

42. Moody's Economy.com, Précis Metro Wichita,.

43. Moody's Economy.com, Précis Metro Hartford.

With more than 22,000 aerospace jobs in the metro, **Forth Worth** is known for military aircraft production. Capturing the 4th-highest ranking in this category, it is home to operations of Lockheed Martin.[44]

Though it has lost much of its former dominance in aerospace, **Los Angeles** retains 5th place on the tech pole index. Northrop Grumman is headquartered here, and Boeing still bases major operations in the metro area.[45]

With Raytheon Missile Systems as its largest employer, **Tucson** ranked 6th in this category. Further north, the presence of Boeing provides stability and contributes to a diverse high-tech industry base in 7th-ranked **Phoenix.**

Montréal is Canada's top performer in this industry, with Bombardier and Pratt & Whitney among its leading firms. Bombardier is headquartered here, accounting for many of the nearly 21,000 aerospace-related jobs in the metro in 2007. Other companies in the region include Air Canada, CAE, and Lockheed Martin.[46] Montréal's aerospace cluster is widely supported though its formidable research capacity, embodied in 197 research centers and four major universities.[47] Furthermore, the presence of the Canadian Space Agency, the Aerospace Technology Manufacturing Centre, and the Industrial Materials Institute create a knowledge-based support infrastructure for innovation and long-term commitment within this industry.[48]

St. Louis, with it long history in aviation, and **Cincinnati** round out the top ten tech poles in this category.

These top-ranked metros have experienced dramatic growth in employment and wages in this category in recent years, as defense projects increased in the post-9/11 era. But as energy prices rose in 2008, airlines began reducing the number of flights and cutting costs. The current downturn has worsened the outlook for aerospace even further, as decreased consumer demand for air travel has resulted in cancelled airline orders. The global recession hit travel worldwide, leading to large-scale layoffs at many firms.[49]

44. Fort Worth Chamber of Commerce, 2008 Major Employers Directory.

45. California Development Department: Major Employers, available at http://www.calmis.ca.gov/file/majorer/MajorER.htm

46. Montréal International, *Attractiveness Indicators 2008*, available for download at http://www.montrealinternational.com/en/pub/documents.aspx

47. Montréal International, Greater Montréal 2006 High Technology and Innovation Indicators, p.23 (available for download at http://www.montrealinternational.com/en/pub/documents.aspx?docs=info).

48. Aéro Montréal, http://www.aeromontreal.ca/site/pages/index.php?lang=en&section=grappeaerospatiale/capaciterecherche (accessed March 11, 2009).

49. Associated Press, "United Technologies CEO Warns of More Job Losses," March 16, 2009 (accessed at http://www.thestreet.com/story/10472826/1/united-technologies-ceo-warns-of-more-job-losses.html?puc=_tscrss). Also Dominic Gates, "Boeing Plans Workforce Reduction," *Seattle Times*, January 9, 2009.

Medical Equipment and Supplies Manufacturing: NAICS 3391

The industry comprises establishments primarily engaged in the manufacturing of laboratory apparatuses and furniture, surgical and medical instruments, and dental equipment and orthodontic goods.

Medical equipment and supplies manufacturing: NAICS 3391
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	2	Minneapolis-St. Paul-Bloomington, MN-WI	15.2	4.0	4.7%	$960	5.2%	100.0
2	4	Santa Ana-Anaheim-Irvine, CA	12.2	3.8	3.8%	$757	4.1%	75.1
3	1	Lake County-Kenosha County, IL-WI	4.6	5.5	1.4%	$620	3.4%	62.9
4	3	Glens Falls, NY	1.9	16.4	0.6%	$105	0.6%	52.4
5	6	Bloomington, IN	2.0	11.6	0.6%	$135	0.7%	44.2
6	5	Salt Lake City, UT	5.8	4.3	1.8%	$289	1.6%	39.6
7	13	New Haven-Milford, CT	3.7	4.6	1.1%	$257	1.4%	29.1
8	12	Rochester, NY	3.6	3.3	1.1%	$350	1.9%	25.6
9	9	Kalamazoo-Portage, MI	1.9	6.1	0.6%	$178	1.0%	25.3
10	16	Indianapolis, IN	4.5	2.3	1.4%	$348	1.9%	19.5

Sources: BLS, Moody's Economy.com, Statistics Canada.

Despite the current downturn, demand for health-care services and medical products continues to exhibit tremendous gains and future potential, thanks in part to an aging baby boomer population. Those regions at the forefront of medical innovation will be in better position to overcome some of the negative impacts of a broader economic slowdown.

Minneapolis–St. Paul–Bloomington posts the largest number of jobs in this category, capturing the largest share of employment and wages across North America. Home to 3M and Medtronic,[50] the region has specialized in the field of medical equipment manufacturing, resulting in its top ranking on this industry's tech pole index. The Minneapolis area has earned a reputation as one of North America's top life sciences centers.

Santa Ana–Anaheim-Irvine ranked 2nd, sharing similar economic characteristics with respect to the industry's relative size. In addition, the metro's exposure to a diverse array of high-tech establishments combined with a talented workforce provides great stability for the region. The presence of Baxter Healthcare places the **Lake County–Kenosha County** metro area (part of Greater Chicago) 3rd on the list.

Glens Falls, New York, and **Bloomington, Indiana,** take the 4th and 5th spots in this category, respectively. Among the top ten, they share the two highest location quotients; their employment concentration in the industry is far higher than in the nation as a whole. Both regions have also experienced the fastest growth since 2003 in terms of employment and wages. The presence of C.R. Bard and Boston Scientific in Glens Falls, and of Cook and Baxter International in Bloomington, has contributed to the industry's dynamic growth in these two locations.

Salt Lake City's medical equipment industry has managed to capitalize on the metro area's growing health-care sector to gain a 6th-place spot on the tech pole index. Some 5,800 local workers are employed within the medical supplies industry. Brigham Young University has played a major role in promoting the metro's life sciences sector; the region has been able to successfully capitalize on its R&D assets, as evidenced by the commercialization and formulation of start-ups in the area.[51]

50. Minneapolis Regional Chamber of Commerce, "Largest Public Companies in Minnesota," *2006 Fact Book* (available at http://www.minneapolischamber.org/largestpublicco.php).

51. Ross DeVol and Armen Bedroussian, *Mind-to-Market: A Global Analysis of University Biotechnology Transfer and Commercialization* (Milken Institute, 2006), p. 117.

Similarly, **New Haven's** medical devices industry, ranking 7th on the index, contributes toward its vibrant life sciences sector. The presence of Yale University yields an abundance of high-quality research and talent. In 8th-ranked **Rochester, New York,** manufacturing expertise in high-tech industrial and commercial machinery has led to the development of specific instruments catering to the life sciences sector. The presence of Pfizer (although it is primarily classified as a pharmaceuticals company) has helped put the 9th-ranked **Kalamazoo, Michigan,** area on the map in this industry.

Among Canadian metros, Toronto and Vancouver rank 47th and 52nd, respectively. Although 3,500 Toronto workers are employed in this field, they account for a relatively small part of Toronto's overall industry base.

Software Publishers: NAICS 5112

This industry encompasses companies that focus either on publishing computer programs, publishing and recopying them, or engaging in the full development process of designing, documenting, supporting, and publishing computer software.

Software publishers: NAICS 5112

Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	1	Seattle-Bellevue-Everett, WA	46.3	17.2	16.5%	$7,162	23.4%	100.0
2	2	Cambridge-Newton-Framingham, MA	16.7	11.0	5.9%	$2,246	7.3%	21.4
3	3	Boulder, CO	5.6	18.2	2.0%	$653	2.1%	11.7
4	5	San Jose-Sunnyvale-Santa Clara, CA	10.5	6.2	3.7%	$2,643	8.6%	9.7
5	4	San Francisco-San Mateo-Redwood City, CA	11.6	6.3	4.1%	$1,614	5.3%	8.4
6	NA	Ottawa, ON	6.4	8.3	2.3%	$462	1.5%	5.7
7	7	Raleigh-Cary, NC	5.5	5.7	1.9%	$515	1.7%	3.5
8	6	Provo-Orem, UT	3.1	8.9	1.1%	$240	0.8%	3.1
9	14	Vancouver, BC	7.1	3.7	2.5%	$386	1.3%	2.7
10	12	Portland-Vancouver-Beaverton, OR-WA	6.6	3.4	2.3%	$625	2.0%	2.5

Sources: BLS, Moody's Economy.com, Statistics Canada.

The strength of industry titan Microsoft and its affiliated companies gives the **Seattle** metro area a decisive lead in this category. Seattle's dominance is demonstrated by the fact that it held a 23.4 percent share of North American wages and a 16.5 percent share of North American employment in this category in 2007.

Although the **Cambridge, Massachusetts,** metro area is not the home to any single dominant software employer, its cluster of smaller, diversified software firms has matured, allowing the region to maintain its 2003 position as the second major center of the software industry in North America. The historic concentration of technology firms and venture capital in the area, combined with technology offshoots from research universities such as MIT and Harvard, has provided the metro with a consistent stream of resources for maintaining its position.

The highest concentration of software publishing employment relative to metro size is actually found in **Boulder, Colorado,** with an LQ of 18.2, placing the metro 3rd in the tech pole ranking. Software publishing employment in Boulder is concentrated in divisions of IBM and Sun Microsystems.[52]

The 4th-ranked **San Jose** metro area, meanwhile, continues to benefit from the sheer concentration of computer-related talent in Silicon Valley as it continues to maintain a strong software firm presence,

52. Moody's Economy.com, Précis Metro Boulder.

with an employment base of more than 10,000 workers. **San Francisco** places 5th on the tech pole index for this category, driven by Oracle and boutique software firms.

The **Raleigh-Cary, North Carolina,** metro area is 7th in North America in software, anchored by statistical software powerhouse SAS. **Provo-Orem, Utah,** places among the leaders as well; it is home to major operations of Novell.

Among Canadian cities, both Ottawa and Vancouver make the top ten based on 2007 data. Sixth-ranked **Ottawa** has done particularly well, with a number of software companies either headquartered in the metro area or basing large operations there. **Vancouver** showed the greatest rise among the top ten, climbing from 14th place in 2003 to 9th place in 2007. In Vancouver's case, the video game industry has been a significant contributing factor, with a number of development studios owned and operated by larger publishers (like Electronic Arts) operating in the area. In addition, Microsoft has also made efforts to develop branch operations here.[53]

Motion Picture and Video Industries: NAICS 5121

The motion picture industry remains one of the most concentrated industries in the list, even with the recent spate of location filming and runaway production. The **Los Angeles** metro area employs more people in the industry sector than the other nine cities in the top ten combined. L.A. retains most of the main value-added portions of the sector, with over half of all wages in the industry being concentrated there (52.7 percent). This industry classification code is included in our analysis order to capture the high-end special effects and other technically skilled production and post-production talent.

Motion picture and video industries: NAICS 5121
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	1	Los Angeles-Long Beach-Glendale, CA	123.0	11.7	31.8%	$11,185	52.7%	100.0
2	2	New York-White Plains-Wayne, NY-NJ	31.4	2.4	8.1%	$3,187	15.0%	5.0
3	6	Vancouver, BC	8.8	3.3	2.3%	$342	1.6%	1.6
4	3	Montreal, QC	10.6	2.5	2.7%	$366	1.7%	1.4
5	9	San Jose-Sunnyvale-Santa Clara, CA	5.1	2.2	1.3%	$63	0.3%	0.6
6	4	Toronto, ON	7.7	1.3	2.0%	$270	1.3%	0.5
7	10	Nashville-Davidson--Murfreesboro, TN	3.2	1.7	0.8%	$166	0.8%	0.3
8	8	Salt Lake City, UT	2.8	1.7	0.7%	$46	0.2%	0.2
9	27	New Orleans-Metairie-Kenner, LA	2.5	1.9	0.6%	$80	0.4%	0.2
10	5	San Francisco-San Mateo-Redwood City, CA	3.2	1.3	0.8%	$256	1.2%	0.2

Sources: BLS, Moody's Economy.com, Statistics Canada.

As is to be expected from its role as a historic center of television as well as independent filmmaking and other entertainment and culture, **New York** is clearly established in 2nd place. Another U.S. metro that has been doing particularly well in the movie industry, particularly between 2003 and 2007, is 5th-ranked **San Jose.** Not only is the area home to computer animation powerhouse Pixar, but it also boasts numerous post-production and special-effects facilities.

Canadian metros have commanded a greater role in movie and television production for several years. A combination of tax credits and a weaker Canadian dollar managed to lure a significant amount of television

53. BC Stats, *Profile of the British Columbia High Technology Sector 2007* (available for download at http://www.bcstats.gov.bc.ca/data/bus_stat/busind/hi_tech.asp)..

and movie production away from Los Angeles as well as other parts of the United States. Although Canada is no longer quite as inexpensive as a filming location, the combination of tax credits and skilled workers remains a draw. **Vancouver,** in particular, has seen its position rise from 6th place in 2003 to 3rd in 2007, predominantly due to its ability to lure television series production.

The city with the most dramatic rise in motion picture production between 2003 and 2007 was **New Orleans,** which climbed from 27th place in 2003 all the way to 9th place among North American metros by 2007. Although Louisiana had already lured some production to the state with tax incentives, it accelerated that effort with additional significant incentives in the wake of Hurricane Katrina, hoping to attract not only individual films but also permanent production facilities. The most prominent of these recent developments is Louisiana Cinema City, built in New Orleans, which includes eight separate soundstages.[54]

Nashville, Salt Lake City, and **San Francisco** are in the top ten as well.

Telecommunications: NAICS 517

This category includes companies that provide telecommunications services or provide direct support to service providers. These services include voice, data, sound, text, and video, and include cable and satellite television broadcasting (but not content creation), Internet service providers, Voice-over-Internet providers (VoIP), and service resellers.

Telecommunications: NAICS 517
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	2	Atlanta-Sandy Springs-Marietta, GA	37.9	2.0	3.2%	$2,856	3.8%	100.0
2	4	Dallas-Plano-Irving, TX	35.1	2.2	3.0%	$2,417	3.2%	97.1
3	1	Kansas City, MO-KS	23.1	3.0	2.0%	$1,902	2.5%	94.9
4	3	Denver-Aurora, CO	22.6	2.4	1.9%	$2,021	2.7%	74.4
5	5	Washington-Arlington-Alexandria, DC-VA-MD-WV	29.1	1.6	2.5%	$2,759	3.7%	62.1
6	6	Edison, NJ	16.7	2.1	1.4%	$1,706	2.3%	51.1
7	7	San Diego-Carlsbad-San Marcos, CA	17.5	1.7	1.5%	$2,177	2.9%	50.6
8	8	New York-White Plains-Wayne, NY-NJ	36.9	0.9	3.2%	$3,177	4.2%	43.4
9	10	Seattle-Bellevue-Everett, WA	18.3	1.6	1.6%	$1,463	2.0%	39.1
10	9	Chicago-Naperville-Joliet, IL	30.0	1.0	2.6%	$2,212	3.0%	38.8

Sources: BLS, Moody's Economy.com, Statistics Canada.

Atlanta moved from 2nd to 1st place from 2003 to 2007, propelled by the consolidation of Cingular and AT&T Wireless into AT&T's Mobility division, which remains headquartered in the metro area. This helped to offset job losses caused by the acquisition of Bell South by AT&T. As of 2007, 21,143 workers were employed in the region by AT&T. Another significant industry player is Cox Enterprises, a large cable company headquartered in Atlanta, which employed an additional 6,832.[55]

The **Dallas** metro area, which came in 2nd in this industry's tech pole index, remains a hotbed of activity in telecommunications, with a number of support and research centers located in the Dallas-Richardson-Plano

54. Bashirah Muttalib, "Louisiana Opts for Local Film Incentives," *Variety*, February 9, 2006 (accessed at http://www.variety.com/article/VR1117937774.html?categoryid=8&cs=1, March 2009).

55. Moody's Economy.com, Précis Metro Atlanta.

corridor. Verizon is one of the largest employers, generating 13,800 local jobs.[56] Dallas rivals both Atlanta and New York in terms of total employment in this industry, although its wages are slightly lower.

Kansas City, the former leader in the category, fell from 1st place to 3rd as Sprint, the metro area's largest employer, has seen recent declines. It still employs more than 14,000 local workers, however, and telecommunications remains one of the most important industries in the region.[57] **Denver** places 4th in this industry. Anchor firm Qwest Communications is the largest employer in the metro area, with more than 9,000 employees. The **Washington, D.C.,** metro area comes in at 5th place on the tech pole index, with many leading firms on located on its Dulles telecom corridor. Sixth-place **Edison, New Jersey,** still has many jobs with AT&T, and ranking 7th, **San Diego** is a major telecommunications hub as well.

The **New York** metro area**,** the historic home of the old AT&T and the one-time hub of the telecommunications industry, claims the largest share of North American wages and is the second-largest center of employment in the sector, led by the presence of Verizon. **Seattle** and **Chicago** round out the top ten.

The highest-ranking Canadian metro in the telecommunications industry is **Toronto,** which comes in at 16th on the index.

Data Processing, Hosting, and Related Services: NAICS 518

This industry includes not only data processing and service companies, but also firms that host websites and various Internet portals.

Data processing services: NAICS 518
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	2	San Jose-Sunnyvale-Santa Clara, CA	4.7	2.7	1.6%	$3,642	11.5%	100.0
2	3	Dallas-Plano-Irving, TX	14.5	3.7	5.1%	$1,636	5.1%	20.4
3	1	Washington-Arlington-Alexandria, DC-VA-MD-WV	13.3	3.0	4.7%	$1,732	5.5%	15.9
4	8	Charlotte-Gastonia-Concord, NC-SC	6.4	4.0	2.3%	$815	2.6%	12.2
5	6	Atlanta-Sandy Springs-Marietta, GA	10.2	2.2	3.6%	$1,292	4.1%	10.8
6	5	Omaha-Council Bluffs, NE-IA	5.2	6.0	1.8%	$470	1.5%	10.4
7	7	San Francisco-San Mateo-Redwood City, CA	3.9	2.1	1.4%	$962	3.0%	8.1
8	10	New York-White Plains-Wayne, NY-NJ	14.4	1.5	5.1%	$1,776	5.6%	7.3
9	14	Kansas City, MO-KS	6.3	3.3	2.2%	$600	1.9%	7.2
10	9	Cambridge-Newton-Framingham, MA	5.1	3.4	1.8%	$595	1.9%	6.0

Sources: BLS, Moody's Economy.com, Statistics Canada.

The top spot in this category is held by the **San Jose** metro area (Silicon Valley). Home to the two most prominent search engines, Google and Yahoo!, it manages to convincingly hold the top spot despite only having a 1.6 percent share of North American employment in the category. But because of the very large value-added nature of these search companies and high-end web portals, the region captures 11.5 percent of the wages in the category, more than twice the amount of its nearest competitor.

Dallas remains in a strong position in the category, moving from 3rd to 2nd and building on its related strength in telecommunications. The metro area is home to a number of data-processing centers, and Electronic Data

56. Moody's Economy.com, Précis Metro Dallas.

57. Moody's Economy.com, Précis Metro Kansas City.

Systems employs 8,300 people in the region.[58] **Washington, D.C.'s** drop from 1st to 3rd has a great deal to do with the declining role of traditional dial-up Internet providers, a trend that has impacted the fortunes of AOL, which is based in the metro. However, the region maintains a significant employment base in data processing, with Computer Science Corporation heavily involved in this field.

Charlotte, North Carolina, ranked 4th on this industry's tech pole index. The city has emerged as a major banking center, and anchor firms such as Bank of America have a tremendous need for data processing and hosting services. (Recent turmoil in the banking sector, however, may affect its future prospects.)

Atlanta, Omaha, San Francisco, and **New York** hold the next four positions. The most significant rise in the rankings in this industry was posted by **Kansas City,** which climbed from 14th in 2003 to 9th in 2007. As cell phones continue to play a larger role in data hosting and transmission, Sprint's presence in the city will continue to fuel expansion in this area. The **Cambridge** metro area rounds out the top ten.

Canadian metros do not perform well in the overall rankings for data processing and hosting. Toronto posted the best results, coming in at 53rd place, while Montréal placed 83rd.

Other Information Services: NAICS 5191

This category includes news syndicates, libraries and archives, and Internet publishing, broadcasting and web search portals. Because web search portals were previously considered a separate category prior to the 2007 NAICS definition (as category 5181), a significant change in the rankings took place.

Other information services: NAICS 5191
Top ten ranked by 2007 tech pole scores

Rank	2003 rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	7	Los Angeles-Long Beach-Glendale, CA	7.1	1.7	4.7%	$724	21.2%	100.0
2	72	San Jose-Sunnyvale-Santa Clara, CA	7.1	7.8	4.6%	$92	2.7%	43.6
3	1	New York-White Plains-Wayne, NY-NJ	13.1	2.5	8.6%	$707	20.7%	41.0
4	4	Glens Falls, NY	0.5	9.1	0.3%	$45	1.3%	16.3
5	2	Toronto, ON	4.9	2.1	3.2%	$183	5.4%	12.3
6	3	Washington-Arlington-Alexandria, DC-VA-MD-WV	3.2	1.3	2.1%	$237	6.9%	7.6
7	NA	Montreal, QC	2.7	1.6	1.8%	$72	2.1%	4.5
8	5	Vancouver, BC	1.9	1.8	1.3%	$70	2.0%	4.3
9	34	Seattle-Bellevue-Everett, WA	2.3	1.6	1.5%	$55	1.6%	3.2
10	46	Provo-Orem, UT	0.9	4.5	0.6%	$6	0.2%	3.0

Sources: BLS, Moody's Economy.com, Statistics Canada.

San Jose, in particular, was dramatically affected by the new definition. The reclassification of web portals in the category led to an enormous boost in the rankings from 72nd to 2nd. As the home of Google and Yahoo!, Silicon Valley posts a strong performance in this field.

The leading metro in the industry is **Los Angeles,** which itself saw a significant rise from 7th to 1st place from 2003 to 2007. Although total employment in the field in Los Angeles is only 55 percent of the total in New York, L.A.'s wage levels exceed those in New York. Strong ties to entertainment industry giants such as Fox and Disney help to secure the strong value-added position of this industry in Los Angeles.

58. Moody's Economy.com, Précis Metro Dallas.

New York, the historic leader in news and related services, dropped from 1st to 3rd in this tech pole index, but retains a strong position in many categories, particularly in wages, where the metro accounts for over one-fifth of all North American wages in the sector, slightly behind Los Angeles. **Washington, D.C.,** fell from 3rd to 6th.

Fourth place is held by **Glens Falls,** a small metro in upstate New York (near Vermont). Its strong ranking is almost entirely due to its role as an information gathering and distribution center for Tribune Media Services, which employs 400 people in the metro.[59]

Three Canadian metros make the top ten, led by **Toronto** in 5th place. Toronto, in fact, has the third-highest share of this industry's wages of any North American metro, and the fourth-highest share of its employment. The city of Toronto on its own is home to 80 firms in the category, employing more than 2,500 workers.[60] Both Toronto and **Vancouver** matched Washington, D.C., in terms of decline, with both falling three places in the rankings.

Architectural, Engineering, and Related Services: NAICS 5413

This industry combines the planning and design of residential, public, industrial, and commercial buildings with the physical engineering, testing, and design of public structures and infrastructure. It also includes landscape design, drafting, building inspection, surveying, mapping, and all testing services not classified as medical, veterinary, or automotive.

Architectural, engineering, and related services: NAICS 5413
Top ten ranked by 2007 tech pole scores

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	2	Houston-Sugar Land-Baytown, TX	62.5	2.3	3.9%	$6,742	5.8%	100.0
2	1	Warren-Farmington Hills-Troy, MI	39.7	3.2	2.5%	$3,505	3.0%	81.1
3	7	Calgary, AB	25.6	4.0	1.6%	$1,421	1.2%	59.3
4	3	Huntsville, AL	13.9	6.3	0.9%	$1,209	1.0%	56.5
5	4	Washington-Arlington-Alexandria, DC-VA-MD-WV	48.3	1.9	3.0%	$4,185	3.6%	55.8
6	6	Denver-Aurora, CO	27.1	2.1	1.7%	$2,354	2.0%	35.5
7	5	Cambridge-Newton-Framingham, MA	19.7	2.3	1.2%	$2,161	1.9%	29.8
8	8	San Diego-Carlsbad-San Marcos, CA	24.0	1.7	1.5%	$2,403	2.1%	27.6
9	9	Santa Ana-Anaheim-Irvine, CA	24.0	1.5	1.5%	$2,486	2.1%	24.4
10	10	Atlanta-Sandy Springs-Marietta, GA	31.1	1.2	1.9%	$2,445	2.1%	23.0

Sources: BLS, Moody's Economy.com, Statistics Canada.

With strong concentrations of construction and engineering services related to energy, the **Houston** metro area has pushed into the top spot in this broad category. Some 62,500 local workers are employed in construction and engineering, the fourth-highest total of any employment sector.

Warren, Michigan, the former number one, has slipped to number two, as the economic slump has been particularly hard on Michigan. This industry remains the fourth-largest employer in the metro, with nearly 40,000 workers. The metro is a hub for alternate-energy research and various engineering offshoots from the auto industry, but the declining state of that industry may limit further growth, however.

59. Moody's Economy.com, Précis Metro Glens Falls.

60. City of Toronto statistics, available at http://www.toronto.ca/business/pdf/tbd_naics_rollup.pdf.

Another city that benefited strongly from the 2007 energy price spike was **Calgary.** The metro area rose from 7th to 3rd in the architecture and engineering industry largely because of its role as Canada's energy hub and its proximity to the Alberta oil sands. Several major pipeline companies are headquartered here, including TransCanada Corporation and Enbridge.[61]

Fourth-ranked **Huntsville, Alabama**, unlike the other metros on the list, is almost entirely dominated by government-related engineering work, rather than work from the private sector. The Redstone Arsenal continues to be the metro's largest employer, with thousands of employees heavily involved in rocket and missile design and construction. When combined with NASA's Marshall Space Flight Center and numerous related employers such as Teledyne Brown, Northrop Grumman, and DirecTV, the impact of this field in Huntsville will continue to remain strong.[62]

Washington, Denver, Cambridge, San Diego, Santa Ana, and **Atlanta** are all top ten tech poles.

The 2007–2008 surge in energy prices created a significant impetus for firms to spend on energy exploration and infrastructure. But the recent economic downturn and consequent decline in prices has led to a reversal of this trend. Future data for the period following 2007 is likely to show a marked decline in this category in most metros.

Computer Systems Design and Related Services: NAICS 5415

This category refers to the part of information technology that includes customized operating systems design, the planning and designing of computer systems hardware, on-site systems and data management, and consulting and support for such systems.

Computer systems design and related services: NAICS 5415
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	1	Washington-Arlington-Alexandria, DC-VA-MD-WV	127.0	5.3	8.5%	$14,588	10.8%	100.0
2	2	San Jose-Sunnyvale-Santa Clara, CA	49.5	5.5	3.3%	$10,281	7.6%	50.7
3	3	Cambridge-Newton-Framingham, MA	29.1	3.6	1.9%	$4,080	3.0%	16.7
4	8	San Francisco-San Mateo-Redwood City, CA	28.9	3.0	1.9%	$3,503	2.6%	12.6
5	4	Bethesda-Gaithersburg-Frederick, MD	20.3	3.6	1.4%	$2,015	1.5%	10.4
6	9	New York-White Plains-Wayne, NY-NJ	56.7	1.1	3.8%	$7,712	5.7%	9.5
7	6	Edison, NJ	24.4	2.4	1.6%	$3,043	2.3%	9.1
8	5	Toronto, ON	38.9	1.7	2.6%	$2,324	1.7%	8.7
9	10	Atlanta-Sandy Springs-Marietta, GA	38.2	1.6	2.5%	$3,298	2.4%	8.5
10	12	Chicago-Naperville-Joliet, IL	44.5	1.2	3.0%	$4,853	3.6%	7.8

Sources: BLS, Moody's Economy.com, Statistics Canada.

The metro with the strongest single presence in this field remains **Washington, D.C.** The combination of firms specializing in defense and government contracts with a significant concentration of Internet and telecommunications companies produces a strong local industry. In fact, computer systems design is the largest non-governmental economic sector in the Washington metro, employing 127,000 workers.[63] One of the largest local employers is Computer Science Corporation, with more than 11,000 employees and a very strong focus on systems design. In addition, IBM employs 5,600 local workers who are also largely involved in this field.

61. Calgary Economic Development, http://www.calgaryeconomicdevelopment.com/keyIndustries/Energy/energyOverview.cfm.

62. Moody's Economy.com, Précis Metro Huntsville.

63. Moody's Economy.com, Précis Metro, Washington, D.C.

San Jose retains a dominant position in this field, as it does with most computer-related sectors. The Silicon Valley area is third in total employment in the sector, and actually leads all metros in terms of location quotient. Wages are also significantly higher here, with San Jose capturing 7.6 percent of all wages in this industry yet just 3.3 percent of all employment.

Cambridge maintains its position in 3rd place in 2007, tying with Bethesda, Maryland, for the third-highest location quotient in this category among leading cities. Computer systems design is actually the largest for-profit employment sector in the metro, with more than 29,000 employees, trailing only the numbers for state and local government and universities.[64]

The fastest-rising metro among the top ten is **San Francisco,** which moved from 8th place in 2003 up to 4th place in 2007. The sector is the third-largest employer in the metro, with nearly 29,000 employees. Oracle has a strong presence in the area, with a focus on on-site systems and data management.[65] **Bethesda, Maryland; New York;** and **Edison, New Jersey,** hold the next three positions on the tech pole index for this sector. Employment exceeded 20,000 in each of these metros (with more than 56,000 workers in the New York metro area). **Atlanta** and **Chicago** also make the top ten.

Among Canadian cities, 8th-ranked **Toronto** has the largest concentration of computer systems design, which complements the computer and peripheral manufacturing business in the metro.[66] Nearly 39,000 local workers are employed in this field, though the city's ranking has fallen from 5th place in 2003 to 8th place in 2007. This industry is another field that is likely to be severely affected by the current recession. Sectors requiring capital investments by other industries, such as this one, are more prone to suffer during downturns, so 2008 statistics are likely to show a clear drop.

Scientific Research and Development Services: NAICS 5417

The industry includes establishments mainly engaged in conducting research and experimental development in the physical, engineering, and life sciences. For example, much of the R&D stemming from the biopharmaceuticals manufacturing industry would typically be captured here.

Scientific R&D services: NAICS 5417

Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	Location quotient	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	2	Cambridge-Newton-Framingham, MA	26.0	7.6	4.1%	$3,653	6.1%	100.0
2	1	San Diego-Carlsbad-San Marcos, CA	24.9	4.6	3.9%	$3,845	6.5%	63.2
3	7	Washington-Arlington-Alexandria, DC-VA-MD-WV	34.3	3.4	5.4%	$3,969	6.7%	55.1
4	4	Bethesda-Gaithersburg-Frederick, MD	15.5	6.4	2.4%	$1,571	2.6%	46.1
5	5	Albuquerque, NM	11.1	6.7	1.8%	$1,655	2.8%	44.8
6	3	San Jose-Sunnyvale-Santa Clara, CA	19.3	5.1	3.0%	$2,173	3.7%	44.4
7	15	Durham, NC	9.2	7.7	1.5%	$987	1.7%	34.1
8	14	Philadelphia, PA	22.2	2.8	3.5%	$2,589	4.4%	30.1
9	11	San Francisco-San Mateo-Redwood City, CA	14.0	3.4	2.2%	$2,261	3.8%	24.9
10	12	Boulder, CO	5.7	8.3	0.9%	$733	1.2%	24.1

Sources: BLS, Moody's Economy.com, Statistics Canada.

64. Moody's Economy.com, Précis Metro Cambridge.

65. Moody's Economy.com, Précis Metro San Francisco.

66. Statistics Canada, http://www.statcan.gc.ca/pub/75-001-x/00402/6207-eng.html

Home to world-class institutions like Harvard and MIT, the **Cambridge-Newton-Framingham** metro area has been able to attract high-skilled researchers from across the globe. This large pool of talent has attracted the research divisions of both pharmaceutical and biotech companies, with proximity to research parks and institutions creating a clear competitive advantage. All together, Cambridge has nearly 26,000 workers employed in the industry. Biogen IDEC, Genzyme, Novartis Institutes for Biomedical Research, Millennium Pharmaceuticals, Draper Laboratory, Vertex Pharmaceuticals, and Wyeth are among the top players in the region.[67] The metro continues to raise the bar when it comes to innovation, converting academic research into commercially viable products. It is therefore no surprise that the metro ranks 1st on the industry tech pole index.

Right behind in the rankings is **San Diego–Carlsbad–San Marcos,** another region known for its well-regarded research institutions, namely the Scripps Research Institute and Salk Institute for Biological Studies. With nearly 25,000 workers in scientific R&D services, the area's research infrastructure lends support to a diverse high-tech industry base that includes the life sciences.

With more than 34,000 workers in this field, the 3rd-ranked **Washington, D.C.,** metro area is home to a number of high-tech companies performing R&D with a particular focus on defense and military-related innovation. The region's R&D industy comprises 5.4 percent of all employment and 6.7 percent of all wages disbursed in North America, comprising the highest shares among all metros.

With several federal-level research institutions (such as the National Institutes of Health and the Food and Drug Administration), **Bethesda, Maryland,** has successfully capitalized on its R&D assets. With a highly skilled workforce, the Bethesda area has attracted a diverse group of high-tech companies, thus earning its 4th-place positon on the tech pole index. Similarly, the presence of Sandia National Laboratories, helps place **Alburquerque** in the 5th spot.

The significant concentration of high-tech activity in Silicon Valley contributes to **San Jose's** ranking of 6th place. Home of Cisco Sytems, Intel, eBay, and Stanford University, the metro area boasts an R&D sector that employs more than 19,000 workers, providing support to a wide array of high-tech establishments.[68] Home to Duke University, **Durham** takes 7th place in the tech pole rankings; more notably, it experienced the fastest job growth in the sector since 2003 among the top ten, and the third fastest in North America. The biggest names in this industry in Durham are IBM and GlaxoSmithKline.[69]

Philadephia's dominant position in the life sciences helps its R&D industry take 8th place. In Greater **San Francisco,** R&D in the life sciences has reached new heights. With the presence of Genentech and University of California, San Francisco, its R&D, human capital, and entrepenurial assets are among the best in the world. Finally, **Boulder, Colorado,** rounds up the top ten with the highest location quotient (8.3) on the list, meaning that the metro area's R&D field has an employment concentration that is over eight times larger than the national average.

In Canada, **Montréal** (ranked 40th) and **Toronto** (ranked 41st) are home to 6,100 and 6,800 jobs, respectively, in scientific R&D-related services. There may be opportunies for greater advancement in this area, given their strength in several diverse high-tech industries.

67. Moody's Economy.com, Précis Metro Cambridge.

68. *Silicon Valley/San Jose Business Journal*, 2008 Book of Lists (American City Business Journals, July 2008).

69. Greater Durham Chamber of Commerce, Business Development: Economic Profile 2008 (accessed at http://www.durhamchamber.org/business/economic_profile/).

Medical and Diagnostic Labs: NAICS 6215

This industry directly complements and supports a region's overall health-care services sector. It is comprised primarily of medical laboratories performing analytic and diagnostic services, such as blood analysis or pathology tests. It also encompasses diagnostic imaging centers, using the latest technologies in X-rays, MRIs, and CT scans. Medical radiological labs are essential for early detection of life-threatening diseases.

Medical and diagnostic laboratories: NAICS 6215
Top ten ranked by 2007 tech pole score

Rank	2003 rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	1	Burlington, NC	1.3	14.0	0.6%	$129	1.0%	100.0
2	3	Fort Lauderdale-Pompano Beach-Deerfield Beach, FL	4.0	3.3	1.7%	$289	2.3%	53.5
3	4	Santa Ana-Anaheim-Irvine, CA	5.4	2.3	2.3%	$456	3.7%	52.7
4	7	Los Angeles-Long Beach-Glendale, CA	9.4	1.5	4.0%	$556	4.5%	50.0
5	14	Toronto, ON	6.9	1.9	2.9%	$315	2.6%	45.5
6	2	Philadelphia, PA	5.4	1.8	2.3%	$454	3.7%	41.6
7	8	Kansas City, MO-KS	4.2	2.7	1.8%	$240	1.9%	40.8
8	5	New York-White Plains-Wayne, NY-NJ	9.2	1.1	3.9%	$634	5.1%	37.5
9	6	Tampa-St. Petersburg-Clearwater, FL	3.9	1.9	1.6%	$307	2.5%	32.9
10	9	Phoenix-Mesa-Scottsdale, AZ	4.5	1.5	1.9%	$281	2.3%	26.3

Sources: BLS, Moody's Economy.com, Statistics Canada.

Home to LabCorp,[70] **Burlington, North Carolina,** scores highest on this industry's tech pole index, with an employment concentration that is 14 times higher than the national average. The metro area has effectively capitalized on its geographic proximity to the Research Triangle, and has experienced the highest growth with respect to employment and wages.

With a significant concentration of health-care services, **Fort Lauderdale–Pompano Beach–Deerfield Beach** comes in 2nd on the list. Similarly, **Santa Ana–Anaheim-Irvine** (Orange County) also scores high in this category, as its dominant position in the medical devices industry has created a spillover effect into related medical fields. Just north, **Greater Los Angeles** ranks a close 4th. A leader in biotech, it also has a high demand for specialized health-care services, a combination that has integrated medical and diagnostic labs into the metro area's life sciences sector. The industry in Los Angeles employs more than 9,000 workers, comprising 4.5 percent of the industry's total employment in North America.

A strong position on this industry's tech pole index is typically indicative of the quality and size of a metro's overall health-care sector. A world-class health-care cluster will attract patients from outside the immediate region, and even outside the country, for that matter. **Toronto** is another good example of how its specialization in medical labs is indicative of a thriving overall health-care services sector, while providing a distinct competitive advantage. The industry employs 6,900 workers, the third largest in all North America, contributing towards its rank of 5th in this category.

Home to top-flight hospitals, research institutions, and numerous biopharmaceutical companies, **Philadelphia** has a well-regarded life sciences sector that contributes to its overall rank of 6th on this industry's tech pole index. Its relative concentration of medical laboratories is highly correlated with this overall strength.

70. Alamance County Area Chamber of Commerce, Major Employers, October 2008 (accessed at http://www.choosealamancenc.com/misc/major%20employers.pdf).

Overall High-Tech Performance

A common attribute of all the leading metros on the tech pole index for overall high-tech performance is diversity within the sector. Many metros ranked among the top twenty specialize in multiple high-tech fields, ranging from defense to biopharmaceuticals.

The **San Jose** metro area, Silicon Valley, ranks 1st on the index for overall high-tech strength. Its high-tech employment concentration is four-and-a-half times higher than the national average. It also carries the distinction of having the highest-paid workforce, with wages comprising 5.7 percent of all wages disbursed throughout all high-tech industries in North America.[71] The metro's mix of high-tech industries contributes to its dominance.

Seattle and **Cambridge** rank 2nd and 3rd, respectively. Microsoft and Boeing help elevate Seattle to the top. While Cambridge consistently ranks among the top metros across many high-tech categories ranging from software, computer design, and data processing services, its strength in R&D, supported by world-class research universities, is what sets the metro area apart from the pack.

In **Washington, D.C.,** major defense contractors, led by Lockheed Martin and Northrop Grumman, underpin the metro area's formidable high-tech base, contributing to its overall rank of 4th place. The Washington, D.C., area is also a leader in R&D and computer systems design services.

Greater Los Angeles, which ranks 5th overall, boasts the greatest absolute number of high-tech jobs in all of North America, with more than 375,000 workers representing 4.2 percent of all high-tech employment in North America. Its concentration of aerospace and defense technology, and particularly its dominance in motion pictures, have placed the metro among the top high-tech leaders.

With a whole host of companies headquartered in the region, **Dallas** is a clear leader in communications equipment manufacturing, telecommunications, and data-processing services. It ranks 6th on the tech pole index.

In addition to San Jose, three other California metros rank among top ten: **San Diego** (7th), **Santa Ana** (8th), and **San Francisco** (10th). Audio and video manufacturing, telecommunications, and scientific R&D services are among key high-tech industries in San Diego, while the key drivers of high-tech growth in Orange Country (the Santa Ana area) include medical equipment manufacturing, medical and diagnostic labs, and the measuring, electromedical, and control instruments manufacturing industry. Finally, San Francisco's biopharmaceutical and the related R&D field is clearly among the top in North America.

Canada's overall top-performing metros, **Toronto** and **Montréal,** rank 15th and 19th, respectively. More than 157,000 jobs are generated by Toronto's high-tech industries, the tenth-largest absolute number in North America. The region scores among the top ten in a number of high-tech industries we examined, including manufacturing and reproducing of optical media, biopharmaceuticals, and medical and diagnostic laboratories. **Montréal** boasts more than 127,000 high-tech jobs, with aerospace as a primary driver. Assuming that methodology from Statistics Canada (Canada's public source for labor force data) remained consistent between 2003 and 2007, these two metro areas exhibit the most dramatic changes in the overall high-tech rankings. Toronto improved by ten spots, while

71. As discussed earlier, the 2007 tech-pole rankings across North American metros exclude Mexico. Mexico's state-level data is analyzed later in this report.

Montréal gained eight spots since 2003, both earning a place among the top twenty overall high-tech leaders in North America. Success in these metros has been largely driven by their ability to capitalize on regional assets. Through its many universities and research institutions, both Toronto and Montréal have been able to successfully produce a viable and sustainable human capital base. As a result, from a financial and risk capital perspective, business leaders and investors have found it worthwhile to locate in these regions.

While other metros in Canada have also engaged in various high-tech activities, they appear to have their value-added production activity or services segmented in select areas within the broader high-tech sector. Toronto and Montréal are by far the most diverse high-tech centers in Canada.

Total high-tech results*

Top fifty ranked by 2007 tech pole scores

Current rank	2003 rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	1	San Jose-Sunnyvale-Santa Clara, CA	244.0	4.6	2.7%	$39,559	5.7%	100.0
2	3	Seattle-Bellevue-Everett, WA	226.3	2.7	2.5%	$22,286	3.2%	46.4
3	2	Cambridge-Newton-Framingham, MA	163.6	3.4	1.8%	$19,344	2.8%	45.2
4	5	Washington-Arlington-Alexandria, DC-VA-MD-WV	275.7	2.0	3.1%	$29,182	4.2%	41.8
5	4	Los Angeles-Long Beach-Glendale, CA	376.4	1.6	4.2%	$29,488	4.2%	40.2
6	6	Dallas-Plano-Irving, TX	187.7	1.5	2.1%	$16,467	2.4%	21.8
7	7	San Diego-Carlsbad-San Marcos, CA	136.4	1.8	1.5%	$14,012	2.0%	19.3
8	11	Santa Ana-Anaheim-Irvine, CA	147.0	1.7	1.7%	$11,346	1.6%	17.7
9	9	New York-White Plains-Wayne, NY-NJ	262.0	0.9	2.9%	$26,947	3.9%	16.8
10	8	San Francisco-San Mateo-Redwood City, CA	106.4	1.8	1.2%	$14,012	2.0%	16.1
11	13	Philadelphia, PA	145.4	1.3	1.6%	$13,362	1.9%	14.4
12	12	Atlanta-Sandy Springs-Marietta, GA	164.1	1.1	1.8%	$13,349	1.9%	14.0
13	10	Edison, NJ	103.5	1.7	1.2%	$10,597	1.5%	13.9
14	14	Chicago-Naperville-Joliet, IL	200.0	0.9	2.2%	$17,363	2.5%	13.3
15	25	Toronto, ON	157.4	1.1	1.8%	$8,839	1.3%	12.5
16	15	Oakland-Fremont-Hayward, CA	98.0	1.6	1.1%	$9,903	1.4%	12.1
17	18	Minneapolis-St. Paul-Bloomington, MN-WI	131.0	1.2	1.5%	$10,269	1.5%	11.9
18	17	Denver-Aurora, CO	107.5	1.5	1.2%	$9,156	1.3%	11.9
19	27	Montreal, QC	128.2	1.3	1.4%	$6,918	1.0%	11.8
20	16	Austin-Round Rock, TX	81.5	1.8	0.9%	$7,525	1.1%	11.6
21	21	Houston-Sugar Land-Baytown, TX	151.7	1.0	1.7%	$13,397	1.9%	11.6
22	29	Huntsville, AL	42.5	3.5	0.5%	$2,919	0.4%	10.5
23	20	Phoenix-Mesa-Scottsdale, AZ	124.9	1.1	1.4%	$9,663	1.4%	10.4
24	31	Wichita, KS	50.6	2.9	0.6%	$3,151	0.5%	10.3
25	23	Bethesda-Gaithersburg-Frederick, MD	67.8	2.0	0.8%	$6,219	0.9%	10.2
26	24	Durham, NC	44.4	2.6	0.5%	$4,881	0.7%	9.7
27	28	Portland-Vancouver-Beaverton, OR-WA	88.1	1.5	1.0%	$7,086	1.0%	9.6
28	19	Boulder, CO	34.0	3.5	0.4%	$3,345	0.5%	9.3
29	26	Newark-Union, NJ-PA	84.9	1.4	1.0%	$8,718	1.3%	9.3
30	22	Warren-Farmington Hills-Troy, MI	90.6	1.3	1.0%	$7,816	1.1%	9.0
31	30	Kansas City, MO-KS	82.2	1.4	0.9%	$6,261	0.9%	8.4
32	32	Baltimore-Towson, MD	92.9	1.2	1.0%	$7,695	1.1%	8.3
33	35	St. Louis, MO-IL	85.1	1.1	1.0%	$6,210	0.9%	6.7
34	44	Salt Lake City, UT	54.8	1.5	0.6%	$3,230	0.5%	5.6
35	36	Tampa-St. Petersburg-Clearwater, FL	76.9	1.0	0.9%	$5,038	0.7%	5.6
36	64	Vancouver, BC	69.5	1.1	0.8%	$3,741	0.5%	5.6
37	66	Ottawa, ON	42.8	1.8	0.5%	$2,872	0.4%	5.4
38	34	Raleigh-Cary, NC	45.7	1.5	0.5%	$3,866	0.6%	5.3
39	39	Albuquerque, NM	39.3	1.7	0.4%	$3,239	0.5%	5.2
40	33	Nassau-Suffolk, NY	71.8	1.0	0.8%	$5,815	0.8%	5.1
41	40	Indianapolis, IN	58.9	1.1	0.7%	$4,666	0.7%	4.9
42	38	Fort Worth-Arlington, TX	57.5	1.1	0.6%	$4,414	0.6%	4.8
43	46	Orlando-Kissimmee, FL	63.6	1.0	0.7%	$4,794	0.7%	4.7
44	47	Hartford-West Hartford-East Hartford, CT	48.4	1.3	0.5%	$4,039	0.6%	4.7
45	50	Columbus, OH	57.0	1.0	0.6%	$4,271	0.6%	4.4
46	45	Pittsburgh, PA	63.3	0.9	0.7%	$4,411	0.6%	4.3
47	41	Bridgeport-Stamford-Norwalk, CT	39.0	1.5	0.4%	$3,772	0.5%	4.3
48	49	Palm Bay-Melbourne-Titusville, FL	26.3	2.1	0.3%	$1,987	0.3%	4.1
49	42	Lake County-Kenosha County, IL-WI	35.0	1.5	0.4%	$3,381	0.5%	4.1
50	37	Colorado Springs, CO	27.9	1.8	0.3%	$2,628	0.4%	4.0

Sources: BLS, Moody's Economy.com, Statistics Canada.

*Note: Due to a lack of recent data, Mexico was excluded from these rankings. An analysis of Mexico's 2003 state-level performance is found later in this report.

2003 Tech Pole Rankings for the United States, Canada, and Mexico

In order to establish a complete set of rankings that includes Mexico along with the United States and Canada, it is necessary to utilize data sets from 2003, the most recent year for which we have data for all three countries. Because the data is not as recent as in the 2007 results already discussed, some of the rankings will differ. In addition, because the data for Mexico is at the state rather than the metro level, rankings are issued for entire Mexican states. This pushes up total employment and wage numbers for each Mexican entry, but it also tends to reduce the overall concentration of jobs in each industry, as the entire state must be considered along with its leading city.

As we discuss results for each industry in the pages that follow, it is important to note the most prominent metros in each Mexican state:

- The **Distrito Federal** includes Mexico City and its immediate surrounding area.
- **México** is the state that lies directly to the northwest of the Distrito Federal and includes the city of Toluca as well as many of the suburbs of Mexico City.
- **Querétaro de Arteaga** is located to the north of the Distrito Federal and includes the city of Querétaro.
- **Morelos** is located immediately to the south of the Distrito Federal and is home to the city of Cuernavaca.
- Guadalajara is the main metropolis in **Jalisco.**
- **Chihuahua** includes the city of Chihuahua as well as important cities near the U.S. border, such as Ciudad Juarez.
- **Durango** lies to the south of Chihuahua and includes the city of Durango.
- **Baja California** refers to the state that makes up the northern half of the Baja California peninsula; it includes such cities as Tijuana, Mexicali, and Ensenada.
- **Tamaulipas** lies just to the south of Texas along the Gulf of Mexico, and includes the border cities of Nuevo Laredo, Reynosa, and Matamoros.
- **Sonora** lies just south of Arizona and includes the city of Hermosillo.

A significant number of high-tech industries in Mexico are dominated by foreign firms that have made the decision to locate their factories in close proximity to the United States. Under the Maquiladora Decree of 1989, foreign firms were allowed to build factories with complete foreign ownership of the facilities, provided they leased the land if located near the borders or coast, and intended the products of the factories to be used for export.[72] Because many products made in Mexico are intended for export to the United States or Canada, a significant number of manufacturing facilities are located in industrial zones close to the U.S. border, where they find low costs and abundant space. Because of this trend, the highest rankings for Mexican states in the

72. An overview of the Maquiladora Program is available from the U.S. Department of Labor at http://www.dol.gov/ilab/media/reports/nao/maquilad.htm#i.

various indexes tend to be held by border states like Baja California and Chihuahua rather than traditional manufacturing centers like Jalisco (Guadalajara). The Distrito Federal, home to Mexico City's long-standing concentration of domestic high-tech firms, is the only non-border state to rank in the top ten in multiple categories.

Overall, Mexico continues to improve its high-technology position due to its lower costs for manufacturing as well as its more favorable regulatory environment. Sectors that are more dependent on research and development do well around Mexico City and, to a lesser extent, Guadalajara, but have not flourished as well in the rest of the country. As the skill levels of Mexican workers continue to increase, the country has managed to make strides in categories such as aerospace, in which it had previously only had limited presence.

Industry Results

The first industry we examined was the manufacturing of pharmaceuticals and medicine. The 2003 list of top locations for this category is very similar to the 2007 list; both are dominated by the locations of the traditional pharmaceutical firms, with newer biotech firms such as Amgen and Genentech explaining the presence of Oxnard–Thousand Oaks–Ventura and San Francisco.

Pharmaceutical and medicine manufacturing: NAICS 3254

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Lake County-Kenosha County, IL-WI	16.5	18.1	4.3%	$1,391	5.7%	100.0
2	Newark-Union, NJ-PA	20.8	8.5	5.5%	$2,032	8.3%	68.5
3	Durham, NC	6.3	10.2	1.7%	$931	3.8%	49.4
4	Indianapolis, IN	13.4	6.5	3.5%	$1,260	5.1%	38.6
5	Edison, NJ	15.2	6.4	4.0%	$1,399	5.7%	36.1
6	Distrito Federal	33.7	5.0	8.9%	$568	2.3%	32.7
7	Philadelphia, PA	20.7	4.7	5.5%	$1,704	6.9%	32.6
8	Oxnard-Thousand Oaks-Ventura, CA	5.5	8.1	1.4%	$730	3.0%	28.0
9	San Francisco-San Mateo-Redwood City, CA	5.1	2.3	1.3%	$999	4.1%	10.5
10	New Haven-Milford, CT	3.9	4.5	1.0%	$428	1.7%	8.7

Sources: BLS, Moody's Economy.com, Statistics Canada.

By far the location with the largest total employment in the industry is Mexico's Distrito Federal, with 13,000 more workers than the next highest-ranking metro. As with most of the more established high-tech industries in Mexico, pharmaceutical manufacturing is strongly centered around Mexico City. (The neighboring states of **México** and **Morelos** rank 12th and 19th, respectively.) In addition to the presence of Mexican pharmaceutical manufacturers, the Distrito Federal is also home to operations for several foreign firms. Abbott Labs of the United States and the German firm Bayer each employ more than 2,500 workers there.[73] Among Canadian metros, Montréal ranked 15th in 2003, and Toronto came in at 18th overall.

Turning our attention to the manufacturing of commercial and service industry machinery, the Mexican state of **Jalisco** just misses ranking in the top ten, coming in at 11th, with the state of **Tamaulipas** ranking 15th overall. Jalisco, as the home of Guadalajara, claims many traditional manufacturing operations that are directly related to this industry. Throughout North America, this industry is the one most likely to be centered in traditional

73. Dun and Bradstreet WorldBase, accessed via Lexis/Nexis Total Research System in March 2009.

manufacturing centers, such as **Rochester** (New York), **Bridgeport** (Connecticut), **Montréal**, and Guadalajara. As technologies advance, cities like **San Jose** and **Orlando**, which are home to newer generations of technologies, have made inroads on the list.

Commercial and service industry machinery manufacturing: NAICS 3333

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Rochester, NY	8.8	19.3	6.2%	$632	9.2%	100.0
2	San Jose-Sunnyvale-Santa Clara, CA	4.5	5.9	3.2%	$626	9.1%	25.8
3	Bridgeport-Stamford-Norwalk, CT	4.0	10.5	2.8%	$290	4.2%	17.5
4	Montreal, QC	5.5	4.0	3.9%	$144	2.1%	7.6
5	Orlando-Kissimmee, FL	2.3	2.7	1.6%	$225	3.3%	6.1
6	La Crosse, WI-MN	0.7	10.6	0.5%	$49	0.7%	4.8
7	Minneapolis-St. Paul-Bloomington, MN-WI	3.8	2.5	2.7%	$249	3.6%	4.4
8	Cambridge-Newton-Framingham, MA	2.3	3.2	1.6%	$200	2.9%	4.3
9	Chicago-Naperville-Joliet, IL	5.5	1.6	3.9%	$360	5.2%	4.1
10	Santa Ana-Anaheim-Irvine, CA	2.6	2.1	1.9%	$185	2.7%	2.7

Sources: BLS, Moody's Economy.com, Statistics Canada.

As with many other computer-related areas, the manufacturing of computers and peripherals is dominated by the **San Jose** metro area (Silicon Valley), both in terms of employment and wages. But two Mexican states, **Chihuahua** and **Jalisco,** ranked in the top ten in this category. Chihuahua benefits from its proximity to the U.S. border, attracting a great deal of maquiladora manufacturing of computer parts and related items. Jalisco posts even larger numbers in terms of total wages and employment. It benefits from Guadalajara's role as the historic center of computer manufacturing in Mexico, which is boosted by the presence of foreign firms such as IBM and HP.[74] Canada's highest-ranking city in the category was **Toronto,** in 29th place, with more than 5,200 workers employed in this industry.

Computer and peripheral equipment manufacturing: NAICS 3341

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	San Jose-Sunnyvale-Santa Clara, CA	35.8	23.4	12.7%	$5,348	25.4%	100.0
2	Durham, NC	9.1	20.0	3.2%	$1,052	5.0%	20.7
3	Rochester, MN	5.9	33.3	2.1%	$526	2.5%	17.3
4	Austin-Round Rock, TX	10.9	9.5	3.9%	$1,174	5.6%	11.1
5	Cambridge-Newton-Framingham, MA	10.5	7.4	3.7%	$1,185	5.6%	7.5
6	Boulder, CO	4.6	16.8	1.6%	$471	2.2%	7.3
7	Chihuahua	13.9	11.2	5.0%	$98	0.5%	6.5
8	Jalisco	18.1	8.4	6.4%	$119	0.6%	6.5
9	Binghamton, NY	3.3	16.7	1.2%	$238	1.1%	4.4
10	Boise City-Nampa, ID	4.2	10.1	1.5%	$314	1.5%	3.4

Sources: BLS, Moody's Economy.com, Statistics Canada.

74. Representative Office of Mexico in Europe, Underministry of International Trade Negotiations (http://www.economia-bruselas.gob.mx/sphp_pages/invierte/fichas/ing/jalisco.pdf; accessed March 2009).

In the 2003 rankings, three different Mexican states placed in the top ten for communications equipment manufacturing. **Sonora** was the overall leader in terms of location quotient and ranked 4th overall in terms of employment. Significant employers in the sector in the state include Allied Signal and Circuitos Mexicanos de Nogales.[75] But lower per capita wages than even **Chihuahua** and **Baja California** prevented Sonora from ranking higher. In addition to the three states in the top ten, **Tamaulipas** and **Jalisco** ranked 15th and 16th respectively. Among Canadian metros, **Ottawa** ranked 6th overall and **Montréal** 17th.

Communications equipment manufacturing: NAICS 3342

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	San Jose-Sunnyvale-Santa Clara, CA	10.4	9.1	4.9%	$786	6.6%	100.0
2	Dallas-Plano-Irving, TX	10.5	4.2	5.0%	$1,061	8.9%	85.0
3	Bethesda-Gaithersburg-Frederick, MD	6.3	8.6	3.0%	$438	3.7%	62.8
4	Sonora	7.4	12.6	3.5%	$46	0.4%	57.5
5	San Diego-Carlsbad-San Marcos, CA	4.9	3.0	2.3%	$727	6.1%	49.8
6	Ottawa, ON	4.5	8.6	2.1%	$165	1.4%	40.5
7	Chihuahua	7.5	8.0	3.6%	$67	0.6%	39.0
8	Baja California	5.8	7.9	2.8%	$45	0.4%	28.7
9	Rochester, NY	2.2	3.3	1.1%	$290	2.4%	24.8
10	Fort Lauderdale-Pompano Beach-Deerfield Beach, FL	3.0	3.2	1.4%	$328	2.7%	23.6

Sources: BLS, Moody's Economy.com, Statistics Canada.

One of the most demonstrable results of the North American Free Trade Agreement was the shift of manufacturing of televisions and other audio-video equipment to Mexico. This trend swept not only American companies, but more importantly, Japanese and Korean companies that wanted easier access to the U.S. market. **Baja California** in particular benefited from this trend, capturing over a quarter of all North American employment in this industry in 2003. The state has become the principal location for Asian firms manufacturing televisions for the U.S. market; companies with factories there include Hitachi, JVC, Sharp, Sony, Samsung, Sanyo, LG, and Panasonic.[76] Baja California's dominance in the industry continues to grow, with Sony actually making the decision to close its remaining production facilities in the United States in favor of plants in Baja.[77] **Tamaulipas,** being located near Texas, has also attracted a number of firms, including LG, Panasonic, and Philips.[78]

A lack of complete data prevents the full ranking of Canadian metros in this category for 2003.

75. Ibid. (http://www.economia-bruselas.gob.mx/sphp_pages/invierte/fichas/ing/sonora.pdf; accessed March 2009).

76. Diane Lindquist, "New-Generation TVs Put Baja Plants Back on Track," *San Diego Union-Tribune*, December 24, 2005 (http://www.signonsandiego.com/uniontrib/20051224/news_1n24tv.html, accessed March 2009).

77. Martyn Williams, "Sony to Close Last U.S. TV Factory," *Computerworld*, December 10, 2008 (http://www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=9123160, accessed March 2009).

78. Representative Office of Mexico in Europe, Underministry of International Trade Negotiations (http://www.economia-bruselas.gob.mx/sphp_pages/invierte/fichas/ing/tamaulipas.pdf, accessed March 2009).

Audio and video equipment manufacturing: NAICS 3343

Top ten ranked by 2003 tech pole scores

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Baja California	24.6	74.3	26.0%	$203	8.0%	100.0
2	Tamaulipas	12.3	35.2	13.0%	$130	5.1%	31.3
3	Sonora	5.8	22.0	6.1%	$71	2.8%	11.9
4	San Diego-Carlsbad-San Marcos, CA	2.4	3.3	2.5%	$329	13.0%	5.5
5	Chihuahua	6.1	14.5	6.4%	$54	2.1%	5.1
6	Durango	1.8	13.9	1.9%	$17	0.7%	2.0
7	Austin-Round Rock, TX	3.9	9.9	4.1%	$0	0.0%	1.3
8	Queretaro de Arteaga	1.5	9.0	1.6%	$10	0.4%	0.7
9	Niles-Benton Harbor, MI	0.3	7.5	0.3%	$17	0.7%	0.4
10	Cambridge-Newton-Framingham, MA	1.6	3.4	1.7%	$52	2.0%	0.4

Sources: BLS, Moody's Economy.com, Statistics Canada.

Just as NAFTA boosted television manufacturing among the Mexican border states, it also attracted a significant concentration of electronic component manufacturing. Firms such as Casio, Honeywell, Sanyo, and Sony have component factories in Baja California, often complementing other manufacturing already present in the area.[79] The state ranked second in sector employment, and first in location quotient. However, in the United States, **San Jose** (Silicon Valley), despite only having a third more workers, posted nearly twenty times the total wages of Baja California.

As with the previous sector, a lack of complete data prevents any ranking of the Canadian metros in this category for 2003.

Semiconductor and other electronic component manufacturing: NAICS 3344

Top ten ranked by 2003 tech pole scores

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	San Jose-Sunnyvale-Santa Clara, CA	46.4	14.6	7.9%	$5,669	18.4%	100.0
2	Baja California	34.9	17.1	6.0%	$289	0.9%	27.4
3	Portland-Vancouver-Beaverton, OR-WA	25.2	7.4	4.3%	$1,947	6.3%	21.0
4	Austin-Round Rock, TX	15.0	6.3	2.6%	$1,555	5.0%	15.6
5	Phoenix-Mesa-Scottsdale, AZ	25.1	4.2	4.3%	$1,957	6.3%	12.6
6	Boise City-Nampa, ID	10.5	12.2	1.8%	$580	1.9%	10.8
7	Chihuahua	23.1	8.9	3.9%	$187	0.6%	9.4
8	Burlington-South Burlington, VT	5.1	12.3	0.9%	$427	1.4%	8.4
9	Dallas-Plano-Irving, TX	25.3	3.7	4.3%	$1,648	5.3%	8.0
10	Palm Bay-Melbourne-Titusville, FL	7.4	10.3	1.3%	$494	1.6%	7.5

Sources: BLS, Moody's Economy.com, Statistics Canada.

79. Representative Office of Mexico in Europe, Underministry of International Trade Negotiations (http://www.economia-bruselas.gob.mx/sphp_pages/invierte/fichas/ing/bc_norte.pdf, accessed March 2009).

No Mexican state ranked highly in the manufacturing of navigational, measuring, electromedical, and control instruments, with the state of **Chihuahua** holding the highest position, at 38th, with some 4,000 workers employed in this industry. Among Canadian metros, **Toronto** came in the highest at 31st, with an industry workforce of more than 7,100.

Navigational, measuring, electromedical, and control instruments manufacturing: NAICS 3345

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Los Angeles-Long Beach-Glendale, CA	38.8	3.3	8.2%	$3,762	12.6%	100.0
2	San Jose-Sunnyvale-Santa Clara, CA	22.7	8.8	4.8%	$1,270	4.3%	79.1
3	Cambridge-Newton-Framingham, MA	16.6	6.9	3.5%	$1,341	4.5%	66.4
4	Santa Ana-Anaheim-Irvine, CA	17.9	4.2	3.8%	$1,811	6.1%	62.8
5	Minneapolis-St. Paul-Bloomington, MN-WI	21.4	4.2	4.5%	$1,341	4.5%	44.9
6	Manchester-Nashua, NH	5.9	10.0	1.2%	$448	1.5%	36.0
7	Fort Collins-Loveland, CO	2.0	5.3	0.4%	$307	1.0%	20.5
8	Boulder, CO	4.0	8.7	0.8%	$289	1.0%	19.3
9	Santa Rosa-Petaluma, CA	3.4	6.3	0.7%	$343	1.2%	19.2
10	Phoenix-Mesa-Scottsdale, AZ	11.2	2.4	2.4%	$839	2.8%	16.9

Sources: BLS, Moody's Economy.com, Statistics Canada.

Although no Mexican states or Canadian metros made the North American top ten for the manufacturing or reproduction of magnetic and optical media in 2003, there are still places of note. **Baja California** placed 12th overall, with the state of **Tamaulipas** ranking 16th. **Toronto** is also prominent in the field, ranking 13th overall. As with many other categories, Baja California and Tamaulipas benefit from their location as border states, with Baja being home to large manufacturing operations for recordable media companies such as the Japanese brand Maxell.[80]

Manufacturing and reproducing magnetic and optical media: NAICS 3346

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Oxnard-Thousand Oaks-Ventura, CA	2.2	20.4	3.6%	$367	11.5%	100.0
2	Huntsville, AL	1.9	26.5	3.1%	$139	4.3%	34.5
3	Houston-Sugar Land-Baytown, TX	9.4	11.0	15.6%	$0	0.0%	27.3
4	Anderson, IN	0.8	46.5	1.3%	$33	1.0%	16.3
5	Fort Worth-Arlington, TX	4.0	13.5	6.6%	$0	0.0%	14.2
6	San Jose-Sunnyvale-Santa Clara, CA	1.6	4.8	2.6%	$276	8.6%	13.0
7	Charlotte-Gastonia-Concord, NC-SC	1.2	4.0	1.9%	$196	6.1%	11.6
8	San Antonio, TX	3.1	11.0	5.2%	$0	0.0%	9.1
9	Provo-Orem, UT	0.9	15.2	1.5%	$34	1.1%	5.8
10	Detroit-Livonia-Dearborn, MI	2.1	6.5	3.4%	$89	2.8%	5.3

Sources: BLS, Moody's Economy.com, Statistics Canada.

Mexico has not traditionally had a strong aerospace manufacturing presence. Just as **Wichita** and **Seattle** benefited in the 2003 rankings from the presence of Boeing and Hartford from Pratt & Whitney, **Montréal** has the advantage of being the home of the highly successful Bombardier, a factor that propelled the metro area to a rank of 7th overall. Mexico's highest-ranking state is **Baja California** at 35th, placing it behind **Winnipeg,** Canada, which ranked 28th. No other Mexican state cracked the top 100 in this category.

80. www.maxell.co.jp/e/ir/annual/pdf/2008/ar2008e_p54-55.pdf

However, since 2003 Mexico has been making an increased push to attract this industry. Aerospace exports to the United States more than tripled, from $146.2 million in 2004 to $683.2 million in 2008.[81] In fact, Mexico views aerospace manufacturing as a potential replacement industry as auto parts manufacturing declines. The state of **Querétaro** is most likely to gain prominence in this field, due to the presence of an aerospace parts division of American giant GE and a fuselage division of Canadian Bombardier.[82]

Aerospace product and parts manufacturing: NAICS 3364

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Wichita, KS	32.6	37.9	6.7%	$1,903	6.0%	100.0
2	Seattle-Bellevue-Everett, WA	62.9	15.5	12.9%	$4,645	14.7%	83.4
3	Hartford-West Hartford-East Hartford, CT	19.7	10.6	4.0%	$1,560	5.0%	19.7
4	Fort Worth-Arlington, TX	22.0	9.2	4.5%	$1,593	5.1%	19.1
5	Los Angeles-Long Beach-Glendale, CA	39.9	3.3	8.2%	$2,806	8.9%	11.0
6	Tucson, AZ	11.6	10.9	2.4%	$456	1.4%	7.8
7	Montreal, QC	20.8	4.4	4.3%	$687	2.2%	7.3
8	Phoenix-Mesa-Scottsdale, AZ	14.6	2.9	3.0%	$1,256	4.0%	5.0
9	St. Louis, MO-IL	12.2	3.0	2.5%	$829	2.6%	3.2
10	Bridgeport-Stamford-Norwalk, CT	6.9	5.2	1.4%	$542	1.7%	2.9

Sources: BLS, Moody's Economy.com, Statistics Canada.

The concentration of manufacturing facilities for inexpensive medical equipment and supplies in the Mexican border states has become significant. Not only do **Baja California** and **Chihuahua** have among the highest location quotients of any of the locations listed, they also are the two of the largest overall employers in the sector. Baja, in particular, benefits from its proximity to California, especially the strong biomedical cluster in San Diego. In 2003, Baja California was home to sixty different companies manufacturing medical equipment, of which more than forty were divisions of U.S. firms. Of those, thirteen were actually subsidiaries of San Diego–based companies or corporate divisions.[83]

Medical equipment and supplies manufacturing: NAICS 3391

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole score
1	Baja California	22.2	16.6	5.8%	$159	1.0%	100.0
2	Chihuahua	14.7	8.7	3.9%	$123	0.8%	37.0
3	Lake County-Kenosha County, IL-WI	4.5	4.9	1.2%	$448	2.8%	26.0
4	Minneapolis-St. Paul-Bloomington, MN-WI	11.8	2.9	3.1%	$665	4.2%	18.8
5	Glens Falls, NY	1.9	15.1	0.5%	$91	0.6%	16.5
6	Santa Ana-Anaheim-Irvine, CA	9.4	2.7	2.5%	$546	3.4%	14.6
7	Bloomington, IN	1.8	9.2	0.5%	$108	0.7%	13.7
8	Salt Lake City, UT	5.8	4.3	1.5%	$281	1.8%	13.5
9	Santa Rosa-Petaluma, CA	2.8	6.3	0.7%	$179	1.1%	12.3
10	San Jose-Sunnyvale-Santa Clara, CA	5.0	2.4	1.3%	$479	3.0%	10.2

Sources: BLS, Moody's Economy.com, Statistics Canada.

81. http://www.newswiretoday.com/news/46719/ , accessed March 2009.

82. Joel Millman and J. Lynn Lunsford, "Mexico Seeks a Lasting Share of Aerospace Boom," *Wall Street Journal*, November 28, 2007.

83. Kenn Morris, Cross-Border Business Associates, "Regional Dialogue on the San Diego–Baja California Biomedical Products Industry," briefing paper prepared for the Crossborder Innovation & Competitiveness Initiative, August 10, 2004 (available at http://www.crossborderbusiness.com/publicdocs/2006-CGMktgMaterials/0408-BioMedBriefing-final2.pdf; accessed March 2009).

Software publishing is not one of Mexico's traditional strengths. Canada, by contrast, has attracted divisions of U.S. software and video game companies as well as nurturing homegrown firms; these efforts resulted in **Vancouver, Toronto,** and **Montréal** ranking 14th, 15th, and 23rd, respectively, in 2003. In Mexico, only the **Distrito Federal,** ranking 71st and **Aguascalientes,** ranking 95th, even make the top 100. Even considering the software localization demands in Mexico City, it is noteworthy that the Distrito Federal had only some 1,400 workers employed in software publishing.

Software publishers: NAICS 5112

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Seattle-Bellevue-Everett, WA	36.3	16.7	13.8%	$6,475	25.9%	100.0
2	Cambridge-Newton-Framingham, MA	13.8	10.4	5.3%	$1,620	6.5%	13.5
3	Boulder, CO	6.5	25.2	2.5%	$585	2.3%	13.0
4	San Francisco-San Mateo-Redwood City, CA	14.6	9.3	5.6%	$1,654	6.6%	11.6
5	San Jose-Sunnyvale-Santa Clara, CA	8.7	6.1	3.3%	$1,337	5.4%	5.9
6	Provo-Orem, UT	3.3	12.9	1.3%	$250	1.0%	3.5
7	Raleigh-Cary, NC	5.2	7.3	2.0%	$413	1.7%	2.9
8	Atlanta-Sandy Springs-Marietta, GA	10.5	2.9	4.0%	$1,022	4.1%	2.6
9	Austin-Round Rock, TX	5.4	5.0	2.1%	$541	2.2%	2.5
10	Denver-Aurora, CO	6.0	3.2	2.3%	$555	2.2%	1.6

Sources: BLS, Moody's Economy.com, Statistics Canada.

The growing prominence of independent Canadian film production is evidenced by the high rankings of **Montréal** (3rd) and **Toronto** (5th) in the 2003 rankings for the motion picture and video industries. **Vancouver** ranked 7th, but has been on an upward trajectory since then. In Mexico, the filmmaking industry has historically been highly concentrated around Mexico City, resulting in the very high placement of the **Distrito Federal** in the overall rankings. The ability to export Mexican film and television products to other parts of Latin America as well as a large home market has given the industry cluster around Mexico City a comparative advantage. Its total employment is actually the third-largest of any of the locations on the list. The Distrito Federal's dominance over the rest of Mexico is shown by the fact that even with some location filming by U.S. companies taking place in other parts of the country, no other Mexican state ranked in the top fifty.

In the 2003 rankings, Canadian metros held three of the top ten positions, boosted by the weakness of the Canadian dollar at the time and strong tax incentives. **Montréal,** in particular, held a dominant position, with the third-highest level of total employment and second-highest location quotient among all metros.

Motion picture and video industries: NAICS 5121

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Los Angeles-Long Beach-Glendale, CA	115.7	11.1	27.7%	$9,493	54.1%	100.0
2	New York-White Plains-Wayne, NY-NJ	31.5	2.4	7.5%	$2,700	15.4%	5.3
3	Montreal, QC	12.2	3.0	2.9%	$226	1.3%	1.3
4	Distrito Federal	14.0	1.9	3.4%	$21	0.1%	0.5
5	Toronto, ON	8.5	1.5	2.0%	$114	0.6%	0.4
6	San Francisco-San Mateo-Redwood City, CA	3.8	1.5	0.9%	$308	1.8%	0.4
7	Vancouver, BC	4.3	1.8	1.0%	$70	0.4%	0.3
8	Oakland-Fremont-Hayward, CA	3.0	1.1	0.7%	$256	1.5%	0.3
9	Salt Lake City, UT	3.8	2.6	0.9%	$57	0.3%	0.2
10	San Jose-Sunnyvale-Santa Clara, CA	5.0	2.2	1.2%	$31	0.2%	0.2

Sources: BLS, Moody's Economy.com, Statistics Canada.

Because of the historic monopoly of Telefónicas de México (Telmex), Mexico's telecommunications industry is unusually concentrated. The **Distrito Federal** has nearly twice as many employees in telecommunications as the second-ranked metro, **Atlanta,** although its share of wages is only slightly higher. Nevertheless, the sheer concentration of the Mexican telecommunications industry places Distrito Federal at a much higher level than any other metro or state. Telmex alone is responsible for employing over 42,000 workers in the state.[84] By contrast, telecommunications in Canada were much less concentrated in 2003, with **Toronto** holding the highest position at 32nd place.

Telecommunications: NAICS 517

Top ten ranked by 2003 tech pole scores

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Distrito Federal	82.1	3.4	6.0%	$2,990	4.2%	100.0
2	Atlanta-Sandy Springs-Marietta, GA	43.9	2.3	3.2%	$2,782	3.9%	25.6
3	Kansas City, MO-KS	27.7	3.4	2.0%	$1,782	2.5%	25.5
4	Denver-Aurora, CO	26.0	2.6	1.9%	$2,210	3.1%	24.1
5	Dallas-Plano-Irving, TX	40.9	2.5	3.0%	$2,403	3.4%	23.7
6	Washington-Arlington-Alexandria, DC-VA-MD-WV	31.0	1.6	2.3%	$2,593	3.6%	15.4
7	Edison, NJ	16.4	1.9	1.2%	$1,550	2.2%	12.3
8	San Diego-Carlsbad-San Marcos, CA	15.8	1.5	1.2%	$1,767	2.5%	12.0
9	New York-White Plains-Wayne, NY-NJ	40.3	0.9	3.0%	$3,165	4.4%	10.4
10	Chicago-Naperville-Joliet, IL	33.5	1.0	2.5%	$2,040	2.9%	8.3

Sources: BLS, Moody's Economy.com, Statistics Canada.

Chihuahua is the only Mexican state that ranks in the top ten in the ranking of Internet service providers and web portals. The state has developed as the principal hub of Internet portals in the country, and its strong concentration allows it to place 5th overall. Mexico's need for Spanish-language content helps to ensure that most of the content is generated locally, rather than in the United States. By contrast, Canada's highest-ranking metro in this category, **Toronto**, ranks only 39th.

Internet service providers and web portals: NAICS 518

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Washington-Arlington-Alexandria, DC-VA-MD-WV	21.9	5.1	7.1%	$1,854	7.0%	100.0
2	San Jose-Sunnyvale-Santa Clara, CA	2.5	1.5	0.8%	$1,891	7.1%	83.1
3	Dallas-Plano-Irving, TX	17.4	4.8	5.6%	$1,379	5.2%	76.3
4	Omaha-Council Bluffs, NE-IA	6.5	7.6	2.1%	$381	1.4%	39.9
5	Chihuahua	8.6	6.2	2.8%	$47	0.2%	30.5
6	Atlanta-Sandy Springs-Marietta, GA	10.2	2.3	3.3%	$1,093	4.1%	30.0
7	San Francisco-San Mateo-Redwood City, CA	4.8	2.6	1.6%	$960	3.6%	27.8
8	Charlotte-Gastonia-Concord, NC-SC	5.8	3.9	1.9%	$560	2.1%	25.9
9	Cambridge-Newton-Framingham, MA	6.2	3.9	2.0%	$524	2.0%	22.0
10	New York-White Plains-Wayne, NY-NJ	15.4	1.6	5.0%	$1,212	4.6%	20.6

Sources: BLS, Moody's Economy.com, Statistics Canada.

84. Dun and Bradstreet WorldBase, accessed via Lexis/Nexis Total Research System, March 2009.

The 2003 rankings for the "other information services" category do not include Internet portals and search engines, as do the 2007 rankings, which follow the revised NAICS code rules. In 2003, the concentration of historic news services and electronic news and information purveyors around **New York City** and **Washington, D.C.,** ensured their top ranking. As noted previously, the location of Tribune Media Services in **Glens Falls, New York,** places the metro in an unusually high position, and with a location quotient of 9.5 that significantly outpaces any other metro in the top ten.

In the 2003 rankings, the **Distrito Federal,** the traditional hub of Mexican media and information services, ranked 18th, with this industry employing more than 1,300 workers. No other Mexican state even ranks in the top 100. Both **Toronto** and **Vancouver** rank very strongly in the category, placing 2nd and 5th, respectively. Toronto has the third-highest concentration, employment level, and wage level, with Vancouver actually having the second-highest concentration of any metro.

Other information services: NAICS 5191

Top ten ranked by 2003 tech pole scores

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	New York-White Plains-Wayne, NY-NJ	7.5	1.7	5.2%	$363	15.4%	100.0
2	Toronto, ON	4.6	2.3	3.2%	$146	6.2%	58.7
3	Washington-Arlington-Alexandria, DC-VA-MD-WV	2.4	1.2	1.7%	$188	7.9%	57.1
4	Glens Falls, NY	0.5	9.5	0.3%	$20	0.8%	50.5
5	Vancouver, BC	2.3	2.8	1.6%	$70	3.0%	34.8
6	Nassau-Suffolk, NY	1.6	1.4	1.1%	$86	3.6%	29.2
7	Los Angeles-Long Beach-Glendale, CA	6.8	1.9	4.7%	$44	1.9%	18.7
8	Chicago-Naperville-Joliet, IL	2.1	0.6	1.4%	$93	3.9%	11.2
9	Philadelphia, PA	1.5	0.9	1.0%	$43	1.8%	5.8
10	Pittsburgh, PA	1.3	1.3	0.9%	$25	1.1%	5.0

Sources: BLS, Moody's Economy.com, Statistics Canada.

As described earlier in analysis of the 2007 data, the **Warren, Michigan,** area held a leading position in the 2003 rankings of architectural, engineering, and related services due to the strong presence of various engineering centers in suburban Detroit. Both **Houston** (in 2nd place) and **Calgary** (in 7th place) were boosted by their connections to the petroleum industry. **Edmonton, Toronto,** and **Vancouver** ranked 18th, 19th, and 22nd for 2003, respectively.

As is the case with many other more established high-tech fields, the Mexican architectural and engineering industry is heavily concentrated in Mexico City. As a consequence, the **Distrito Federal,** with a ranking of 44th, is the only Mexican state in the top 100. Despite this result, the strong role of the petroleum industry in Mexico's economy results in significant employment, with more than 21,000 jobs in the state.

Architectural, engineering, and related services: NAICS 5413

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Warren-Farmington Hills-Troy, MI	42.5	3.9	3.0%	$3,332	4.0%	100.0
2	Houston-Sugar Land-Baytown, TX	51.3	2.5	3.6%	$4,595	5.6%	94.4
3	Huntsville, AL	11.2	6.7	0.8%	$855	1.0%	46.2
4	Washington-Arlington-Alexandria, DC-VA-MD-WV	42.6	2.2	3.0%	$2,939	3.6%	43.8
5	Cambridge-Newton-Framingham, MA	18.5	2.6	1.3%	$1,561	1.9%	28.2
6	Denver-Aurora, CO	22.5	2.2	1.6%	$1,586	1.9%	26.5
7	Calgary, AB	15.6	3.6	1.1%	$456	0.6%	24.8
8	San Diego-Carlsbad-San Marcos, CA	19.6	1.8	1.4%	$1,696	2.1%	23.3
9	Santa Ana-Anaheim-Irvine, CA	19.9	1.6	1.4%	$1,766	2.1%	21.7
10	Atlanta-Sandy Springs-Marietta, GA	26.4	1.3	1.9%	$1,734	2.1%	17.9

Sources: BLS, Moody's Economy.com, Statistics Canada.

As noted previously, the **Washington, D.C.,** metro is the single strongest location for computer systems design and related services. In 2003, firms in the D.C. area employed twice as many workers in the industry as in any other metro. Among Canadian metros, **Toronto** had the strongest showing, ranking 5th overall, with **Ottawa** ranking 13th and **Montréal** ranking 15th.

Once again, most Mexican activity in this industry is concentrated around Mexico City, with the **Distrito Federal** ranking 61st overall, and no other Mexican state among the top 100. In fact, with more than 15,000 workers, the Distrito Federal has an employment base in this industry more than three times larger than the next highest-ranking Mexican state, **Jalisco.**

Computer systems design and related services: NAICS 5415

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Washington-Arlington-Alexandria, DC-VA-MD-WV	101.0	5.6	7.9%	$9,695	10.3%	100.0
2	San Jose-Sunnyvale-Santa Clara, CA	44.9	6.4	3.5%	$7,833	8.3%	94.0
3	Cambridge-Newton-Framingham, MA	26.6	4.1	2.1%	$2,819	3.0%	21.4
4	Bethesda-Gaithersburg-Frederick, MD	20.1	4.5	1.6%	$1,557	1.7%	13.7
5	Toronto, ON	40.0	2.2	3.1%	$1,378	1.5%	13.3
6	Edison, NJ	20.7	2.6	1.6%	$2,329	2.5%	12.2
7	Warren-Farmington Hills-Troy, MI	23.8	2.4	1.9%	$2,339	2.5%	11.5
8	San Francisco-San Mateo-Redwood City, CA	20.5	2.7	1.6%	$2,301	2.4%	10.6
9	New York-White Plains-Wayne, NY-NJ	44.5	1.1	3.5%	$5,156	5.5%	10.4
10	Atlanta-Sandy Springs-Marietta, GA	33.6	1.9	2.6%	$2,593	2.8%	10.0

Sources: BLS, Moody's Economy.com, Statistics Canada.

In the 2003 figures, top rankings in scientific research and development services were held by life science hotspots **San Diego** and **Cambridge,** with tech pole index scores far in excess of any other metros. (No rankings for Canadian metros are present due to the lack of data for 2003.) No Mexican state ranked in the top 100 in this category, with the state of **Querétaro** holding the highest position at 119th, employing just 500 people. The **Distrito Federal,** in 150th place, leads in total employment, with more than 1,500 workers engaged in scientific R&D.

Scientific research and development services: NAICS 5417

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	San Diego-Carlsbad-San Marcos, CA	24.4	5.5	4.3%	$2,976	6.9%	100.0
2	Cambridge-Newton-Framingham, MA	20.8	7.2	3.6%	$2,423	5.7%	95.7
3	San Jose-Sunnyvale-Santa Clara, CA	20.1	6.5	3.5%	$1,730	4.0%	54.5
4	Bethesda-Gaithersburg-Frederick, MD	15.0	7.6	2.6%	$1,209	2.8%	51.9
5	Albuquerque, NM	11.0	8.5	1.9%	$875	2.0%	49.9
6	Detroit-Livonia-Dearborn, MI	15.8	5.3	2.8%	$1,495	3.5%	46.2
7	Washington-Arlington-Alexandria, DC-VA-MD-WV	29.4	3.7	5.2%	$2,233	5.2%	45.1
8	Kennewick-Richland-Pasco, WA	4.1	13.6	0.7%	$441	1.0%	37.8
9	Albany-Schenectady-Troy, NY	7.7	4.9	1.3%	$1,035	2.4%	36.9
10	Chicago-Naperville-Joliet, IL	28.3	2.1	5.0%	$2,690	6.3%	33.5

Sources: BLS, Moody's Economy.com, Statistics Canada.

The 2003 rankings in the medical and diagnostic lab category, as with 2007, were led by **Burlington, North Carolina,** where the presence of LabCorp strongly affects the concentration in this relatively small metro. As with the previous sector, the lack of consistent data for 2003 prevents an effective ranking of any Canadian metro.

Although no Mexican state made the top ten in this category, four did rank in the top sixty. These are led by the **Distrito Federal** (34th), followed by **Sonora** (52nd), **Veracruz** (56th), and **Estado de México** (59th). The Distrito Federal's employment level in this field, with 4,500 workers, was more than 2,000 more than any other Mexican state.

Medical and diagnostic laboratories: NAICS 6215

Top ten ranked by 2003 tech pole score

Rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	Burlington, NC	1.2	14.1	0.5%	$103	1.1%	100.0
2	Philadelphia, PA	5.8	2.1	2.5%	$372	4.0%	35.6
3	Fort Lauderdale-Pompano Beach-Deerfield Beach, FL	2.8	2.8	1.2%	$228	2.4%	35.3
4	Santa Ana-Anaheim-Irvine, CA	4.4	2.2	1.9%	$320	3.4%	31.8
5	New York-White Plains-Wayne, NY-NJ	9.0	1.3	3.9%	$526	5.6%	24.6
6	Tampa-St. Petersburg-Clearwater, FL	3.9	2.3	1.7%	$215	2.3%	24.5
7	Los Angeles-Long Beach-Glendale, CA	7.3	1.3	3.2%	$409	4.4%	22.0
8	Kansas City, MO-KS	3.6	2.6	1.6%	$179	1.9%	21.3
9	Phoenix-Mesa-Scottsdale, AZ	4.1	1.7	1.8%	$208	2.2%	17.0
10	Spokane, WA	1.1	3.7	0.5%	$77	0.8%	16.8

Sources: BLS, Moody's Economy.com, Statistics Canada.

Overall High-Tech Performance in 2003

Among tech poles in 2003, no Canadian metro or Mexican state ranked among the top ten for overall high-tech strength. Canada was led by **Toronto** in 27th place and **Montréal** in 29th place. Each of these cities posted high-tech employment well in excess of 100,000 workers, with Toronto actually having high-tech employment of more than 145,000.

The Mexican states of **Baja California** and **Distrito Federal** both did very well in the overall rankings. Baja California claimed a ranking of 15th, with total high-tech employment of 104,000. The Distrito Federal, despite ranking 19th, actually employs nearly 192,000 workers throughout the high-technology sector.

Total high-tech results*

Top twenty ranked by 2003 tech pole scores

2003 rank	Metro area	Employment (thousands)	LQ	Share of North American employment	Wages (US$M)	Share of North American wages	Tech pole scores
1	San Jose-Sunnyvale-Santa Clara, CA	239.5	4.8	2.6%	$29,278	5.3%	100.0
2	Cambridge-Newton-Framingham, MA	155.4	3.3	1.7%	$14,788	2.7%	38.1
3	Seattle-Bellevue-Everett, WA	187.5	2.5	2.0%	$17,043	3.1%	33.9
4	Los Angeles-Long Beach-Glendale, CA	366.9	1.6	4.0%	$23,950	4.4%	31.2
5	Washington-Arlington-Alexandria, DC-VA-MD-WV	251.3	2.0	2.7%	$21,215	3.9%	31.2
6	Dallas-Plano-Irving, TX	185.5	1.7	2.0%	$12,956	2.4%	18.1
7	San Diego-Carlsbad-San Marcos, CA	127.9	1.8	1.4%	$10,924	2.0%	16.1
8	San Francisco-San Mateo-Redwood City, CA	99.8	1.8	1.1%	$10,369	1.9%	13.6
9	New York-White Plains-Wayne, NY-NJ	246.0	0.9	2.7%	$21,079	3.8%	13.1
10	Edison, NJ	101.3	1.8	1.1%	$8,976	1.6%	13.0
11	Santa Ana-Anaheim-Irvine, CA	140.1	1.7	1.5%	$9,247	1.7%	12.8
12	Atlanta-Sandy Springs-Marietta, GA	164.9	1.3	1.8%	$11,181	2.0%	12.0
13	Philadelphia, PA	143.4	1.3	1.6%	$10,567	1.9%	11.6
14	Chicago-Naperville-Joliet, IL	203.0	0.9	2.2%	$14,322	2.6%	11.0
15	Baja California	104.5	3.3	1.1%	$829	0.2%	10.6
16	Oakland-Fremont-Hayward, CA	96.8	1.6	1.1%	$8,028	1.5%	10.3
17	Austin-Round Rock, TX	72.8	1.9	0.8%	$5,951	1.1%	10.0
18	Denver-Aurora, CO	105.2	1.6	1.1%	$7,447	1.4%	9.7
19	Distrito Federal	191.9	1.2	2.1%	$3,964	0.7%	9.6
20	Minneapolis-St. Paul-Bloomington, MN-WI	126.2	1.3	1.4%	$8,344	1.5%	8.8

Sources: BLS, Moody's Economy.com, Statistics Canada.

*Including Mexico.

Methodology

The high-tech sector is defined as encompassing nineteen industries that are broken out by the North American Industry Classification System (NAICS). These are further divided into high-tech manufacturing and high-tech services industry groups as follows:

High-tech manufacturing industries: NAICS and description

3254	Pharmaceutical and medicine manufacturing
3333	Commercial and service industry machinery manufacturing
3341	Computer and peripheral equipment manufacturing
3342	Communications equipment manufacturing
3343	Audio and video equipment manufacturing
3344	Semiconductor and other electronic component manufacturing
3345	Navigational/measuring/medical/control instruments manufacturing
3346	Manufacturing and reproducing magnetic and optical media
3364	Aerospace products and parts manufacturing
3391	Medical equipment and supplies manufacturing

High-tech services industries: NAICS and description

5112	Software publishers
5121	Motion picture and video industries
517	Telecommunications
518	Internet service providers, web search portals, and data processing services
5191	Other information services
5413	Architectural, engineering and related services
5415	Computer systems design and related services
5417	Scientific R&D services
6215	Medical and diagnostic laboratories

Our analysis includes a comparison of metropolitan regions in two years: 2003 and 2007. The metrics of analysis include measurements related to both employment and wages. These were performed for each industry and each metropolitan region in North America (Canada, Mexico, and the United States) in order to draw comparisons. The results were ranked to show the top-performing regions in each high-tech industry.

In the case of Mexico, state-level data were obtained from the Instituto Nacional de Estadistica y Geografica (INEGI). The organization conducts an economic census for Mexico every five years and reports data at the state level. We used the latest dataset available (2003) for analysis in this study. As a result, regional comparison among all three countries was possible only for 2003. The 2007 rankings consist of solely U.S. and Canadian metros.

Metropolitan-level data for the United States were obtained from Moody's Economy.com. These are compiled based on the establishment survey (Quarterly Census of Employment and Wages) from the Bureau of Labor Statistics.

Canadian data were obtained from a combination of the Survey of Employment, Payroll, and Hours (SEPH) and Labour Force Survey (LFS) surveys. The former is an establishment survey at the provincial level, while the latter is a household survey available at both the provincial and Census Metropolitan Area (CMA) levels. Since the methodology of the establishment survey is similar to the regional data in the United States, we ultimately

had to derive CMA-level estimates using SEPH as our benchmark. We applied the ratio of the metropolitan-level employment (or wages) to provincial employment (or wages) in the LFS survey to the provincial data in the SEPH survey, so as to obtain comparable metropolitan-level data. In cases where the SEPH survey data were not available, data from the LFS survey were used to derive estimates.

The sum of the employment (or wages) in each metropolitan region across all nineteen industry codes is the total high-tech employment (or wages) for that particular region.

In addition, in the LFS survey for Canada, wages were reported as average hourly wages. We converted them to annual wages disbursed based on the employment number in the respective industry codes and a forty-hour work week. These values were subsequently converted to U.S. dollars using the conversion rates specified by the Federal Reserve for the respective years: 2003 and 2007.

Tech pole scores were calculated based on the multiplication of location quotients and the respective share of the North American total. These were computed for each industry code for each region, including the high-tech total and were benchmarked to the top-scoring metro, which received an index value of 100.

About the Authors

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